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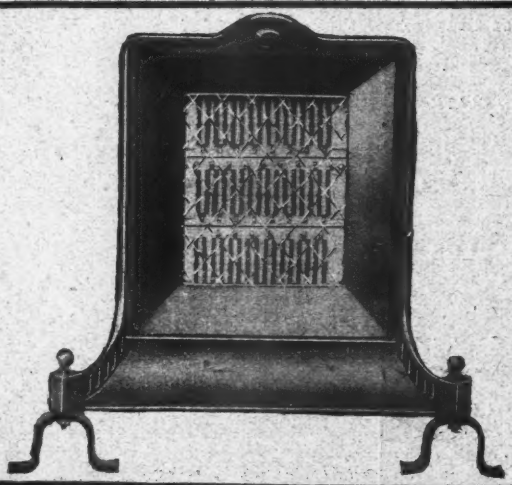

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DEPRECIATION.

It will not be gainsaid that when Mr. F. Gill and Mr. W. W. Cook tackled the thorny question of depreciation of engineering plant, with a view to providing a rational basis of agreement between engineers, accountants, and financiers, they displayed an altruistic courage worthy of the highest praise. Moreover, they set about the undertaking in a manner which commands attention and respect, whether one agrees with their conclusions or not, and they have been rewarded by discussions which, if they reveal the most varied views upon the subject of the paper, at any rate bear witness to the keen interest which it arouses in the minds of those to whom the paper was addressed. The curious difference of opinion displayed, for instance, between the speakers at Birmingham and those at Edinburgh needs some explanation; on the other hand, in Yorkshire "honours were even," and in London the feeling was distinctly in favour of the authors' views.

In approaching this question from an impartial point of view, it should be borne in mind that it is hedged about by a host of divergent and incompatible considerations, some of which, indeed, are wholly irrelevant from a scientific standpoint, but yet exert a controlling influence upon the views of those responsible for decisions. As one speaker remarked at Leeds, expediency only too often overrides all theoretical arguments. One factor, to the admission of which Mr. Cook strongly demurred, is the presence or absence of net profits out of which a due amount can be set aside as a provision for depreciation. Again, in the case of municipal trading undertakings, the question whether the sinking fund (which *must* be provided) truly represents depreciation or should be supplemented by further provision is an old bone of contention; and when the affairs of a company are under consideration, solicitude for the shareholders' dividends, and in the case of a supply or tramway company, the liability to purchase of the undertaking by the local authority, have also to be reckoned with. Add to these factors the accountants' expressed aversion to "complicated book-keeping" and the difficulty which they experience in explaining to business men (is not the adjective misapplied?) any method but the "straight-line system," the impossibility of prophesying the duration of the economic life of an item of plant, the instability of all human affairs such as market prices, taxation, and interest on loans, not to mention wars and earthquakes, and it will be seen that the subject by no means lends itself to exact and rigorous analysis.

The authors necessarily took account only of those factors which could be regarded as strictly relevant to the subject from the point of view of what, without disparagement, we may call pure theory; the science of psychology is still far from the stage at which measurement is possible, and many of the obtrusive extraneous considerations to which we have referred will be seen to lie within its sphere, whilst others are on the knees of the gods. In the case on which the authors based their argument, no doubt the best possible means must be employed to form a reasonable estimate as to the amount of the annual charges upon the plant that is to be installed, especially when widely different alternatives present themselves, such as the choice between steam and gas power, or between manual and automatic telephone switchboards; but once the plant is put in operation, we cannot avoid the conclusion that the conduct of the business, and the decision as to the proper rate and system of depreciation to adopt, must be allowed to depend very largely upon the circumstances of the moment when the annual revision of accounts takes place. No matter what agreement may be reached on theoretical grounds, that is fairly certain to be the actual course adopted in practice.

The subject is of peculiar interest at the present time, when the question of purchase of the Metropolitan supply companies is looming in the not distant future, and the present owners are perforce called upon to have regard to the value that will be placed upon their property, especially in the not unlikely event of purchase before the expiry of the statutory period. Under these conditions, that part of the paper in which the authors deal with "the value of the plant in place" will be of particular interest to them, but whether they will feel it to their advantage to adopt the method of valuation recommended by the authors is somewhat questionable. Moreover, another question here arises—outside the scope of the paper, but of material importance, nevertheless—namely, the value of the plant expressed in terms of the price that it would fetch on its merits in the open market, which would not necessarily bear any definite relation to the value at which it might stand in the books of the company, as depreciated. In this connection, it is impossible to ignore the fluctuations in value that have been, and may be, induced by war conditions, and here, again, no process of analysis avails to take account of all the relevant considerations. The solution will be arrived at by the judicial estimate, otherwise the glorified guesswork, of the arbitrator in the light of rival and highly divergent claims. The authors take no account of goodwill in connection with depreciation, nor could they be expected to do so, though Mr. Selvey introduced it at Leeds; but it is, nevertheless, a factor that will provide abundant scope for forensic eloquence and bills of costs unless the purchase is deferred to the statutory limit.

Not only is the method of allotting depreciation a contentious problem; the question of maintenance is also one that affords much scope for discussion. The precise point where the line should be drawn between repairs and renewals, and the question whether to charge such items to maintenance or to renewals, are proper and prolific subjects for debate. But we have not space to enter upon this wide field. In conclusion, we venture to put forward once more a counsel which is no stranger to our columns, namely, no matter what system of depreciation is adopted, the management will do well to build up, as soon as possible, a substantial reserve fund. Until this is done, no municipal trading department should be depleted of its profits in order to relieve the rates, and no company should declare large dividends for the sake of indicating a prosperity which in the light of subsequent developments may prove illusory.

High-Speed Telegraphy.

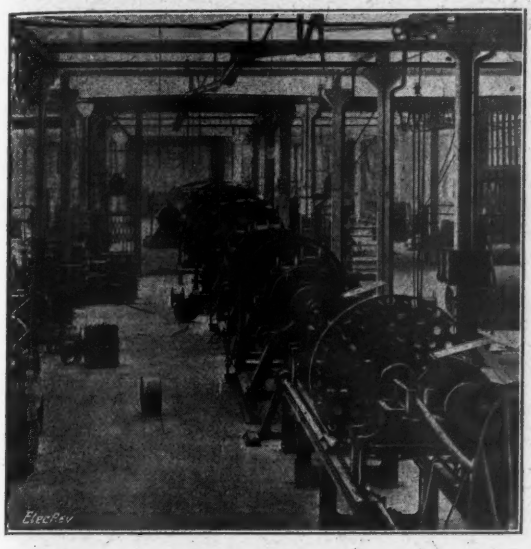
The report on this subject, of which we commence an abstract on another page, while it suffers from the fact that the outbreak of war brought the elaborate experimental investigations which had been contemplated to a sudden standstill, nevertheless marks an epoch in the history of the evolution of high-speed telegraphy in this country. Incidentally, we may congratulate ourselves on the leading position occupied by the British Post Office and British inventors in the development of this interesting branch of the science of long-distance communication, a position to which New Zealand has contributed in no small measure, for several of the most useful and successful devices have been invented by sons of that progressive Dominion—Messrs. John Gell and Donald Murray. The latter in particular has laboured incessantly in this field, and has evolved a remarkable series of apparatus, besides focusing public attention upon the subject by his able writings.

The complexity and almost infinite variety of the inventions which have been developed in the hope of solving the problems of high-speed telegraphy were abundantly illustrated in the classic paper read by Mr. H. H. Harrison before the Institution of Electrical Engineers last year, and it is interesting to note that both he and Mr. Murray have recently joined forces with Messrs. Creed, Bille & Co., who also stand in the front rank in this connection, and will, without doubt, give a good account of themselves thus reinforced in the future.

The Committee's report, without excessive technical detail, tersely outlines the purpose and character of each of the devices that have been tested or put forward, and constitutes an able summary of the present position. It is made clear that the requirements of the British telegraphic service should be closely studied by inventors before they devote their brains to the task of complying with them, for the conditions are by no means simple or obvious. But for the transfer of many of the telegraph lines to the trunk telephone service, it appears that there would have been no special need of high-speed apparatus other than the classic Wheatstone. Even under the conditions thus set up, not every high-speed system is applicable to the traffic requirements, one of the most pressing of which is the necessity of a ready means of communication between the terminal operators, for the purpose of making corrections, &c. Again, the organisation of the traffic presents special problems which would not naturally suggest themselves to the mind of the casual observer. Hence it is that, after mature deliberation, the Committee arrives at the extremely important conclusion that "systems on the multiplex principle are definitely superior to the automatic high-speed systems on the large majority of main circuits for ordinary inland commercial telegraph work." Thus, "at one fell swoop," are swept aside so many ingenious instruments, the fruit of untold pains and lavish outlay. This is the outstanding feature of the report, which goes on to give the palm to the Western Electric Co.'s system, but keeps the door open for others. We believe that Mr. Murray's pioneer work deserves a considerable measure of credit in this connection, but, above all, we must not omit to pay homage to the memory of the French inventor, who is entitled to rank with our illustrious Wheatstone—namely, the originator of the five-unit alphabet and of the modern multiplex system, Baudôt.

THE PIRELLI-GENERAL CABLE WORKS.

Although the new cable factory of the Pirelli-General Cable Works, Ltd., at Southampton, has been in operation for some two years, it was not until last month, owing to the exigencies of the war and the pressure of work, that an official description of the plant was issued by the company. From the excellent brochure which we have now received, we have extracted the following particulars, which, while not pretending to present an adequate account of the establishment, may serve, at any rate, to indicate the nature and scope of the works.



Cable-stranding Machines.

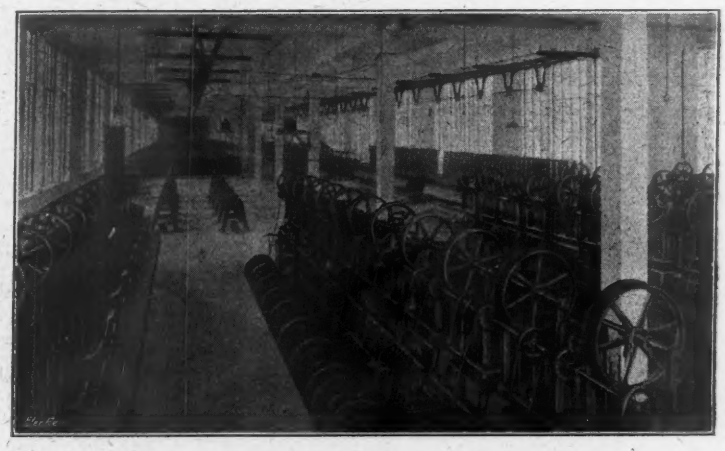
The company was formed jointly by the Italian firm of Pirelli & Co. and the General Electric Co., Ltd., of Great Britain, both concerns of world-wide reputation, and combining commercial experience with technical ability of the highest order. Hence the cable works had the advantage of starting with the support of a huge organisation and vast resources, which guaranteed to it success from the very commencement. Moreover, it was set in operation at a time when the national emergency called for the employment of every possible instrument of production, and has thus been enabled to carry out important contracts for Government departments; at the same time, the circumstances under which it was inaugurated rendered it impossible to signalise the event in the usual manner, and consequently operations were quietly commenced without any public function.

The firm of Pirelli & Co., which has been established for over 40 years, possesses factories at Milan and Spezia in Italy, and at Barcelona in Spain, and employs at Milan alone over 6,000 workers; owing to its progressive character and the excellence of its research department, it has long held a position in the front rank of cable manufacturers. The General Electric Co., Ltd., one of the largest firms of electrical manufacturers in the British Empire, needs no introduction to our readers, with whom its name is a "household word."

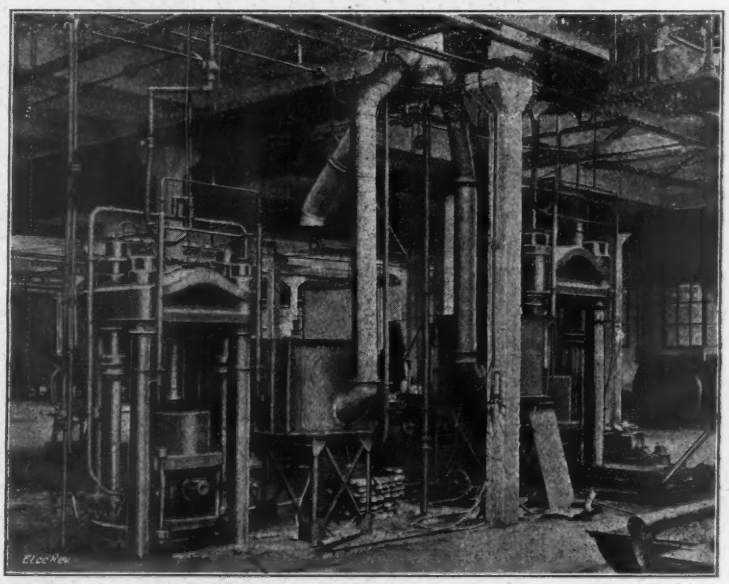
The whole of the plant being entirely new, the works enjoyed the advantage of starting on the most up-to-date lines and with the most efficient types of machinery throughout. The lay-out of the plant is also planned with an eye to the most economical production. A private pier gives access to the site by water, and is equipped with a 10-ton electric crane, while an overhead monorail system with electrical propulsion affords facilities for transporting loads up to 7 tons in weight to any part of the works. The main building is of two storeys, to which others can be added if necessary—but only one-third of the area owned by the company is at present covered, so that there is ample room for extensions. The shops are well lighted and ventilated. The heavy machinery is mounted on the ground floor, where the rubber washing, cleaning, and calendering plant, the stranding and covering machines, the vulcanising and testing tanks, lead presses, and stores are situated. All the machinery is driven by "Witton" motors, which derive their power from the Southampton Corporation mains. A boiler house supplies steam for the cable-heating and drying chambers, and two gas producers provide for the heating of the lead furnaces. The works are lighted with Osram and Osram-Atmos lamps.

The cable machinery is capable of laying up as many as 450 wires in one cable, and can deal with cables up to 1,500 sq. mm. section. Both rubber and paper insulation is employed, the latter type of cable being lead-sheathed. Wire and tape armour is also provided when required.

The testing rooms are of exceptional excellence, being equipped with apparatus for investigating the properties of all the materials used in cable manufacture, and test pressures up to 300,000 volts A.C. are available, the



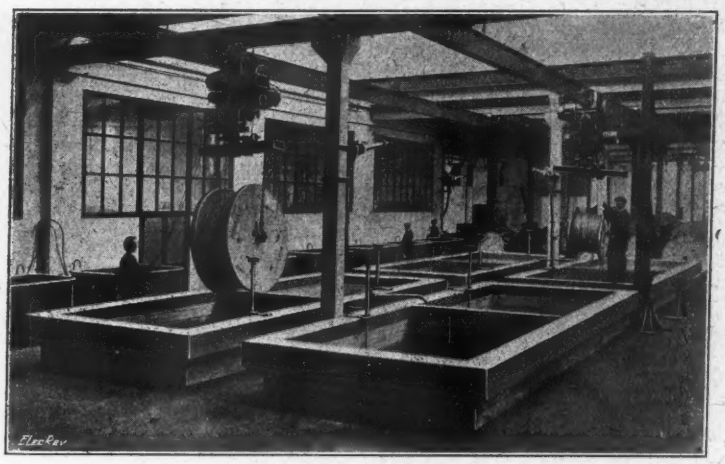
Braiding and Paper-lapping Machines.



Lead Presses for Sheathing Cables.

current being generated by a "Witton" alternator and transformed up. An electrostatic voltmeter of the Jona type, with a maximum range of 200,000 volts, and transformers giving various test pressures, are provided.

On the upper floor machines are installed for the manufacture of the smaller wires and cables for electric lighting, telegraphs and telephones, bells, &c., and afford employment for female labour, which in the past has had little scope in



Cable-testing Tanks.

Southampton. Other departments include offices, stores, repair shops, &c., the last-mentioned being equipped with heavy machine tools capable of making the new machinery for future extensions to the works. We give herewith some views of the cable shops, to illustrate the character of the equipment, which we hope at some future date to describe more fully, and conclude with an expression of our best wishes for the success of the factory in the strenuous times to come.

SOME CONSIDERATIONS AFFECTING THE USE OF ELECTRICITY IN AGRICULTURE.

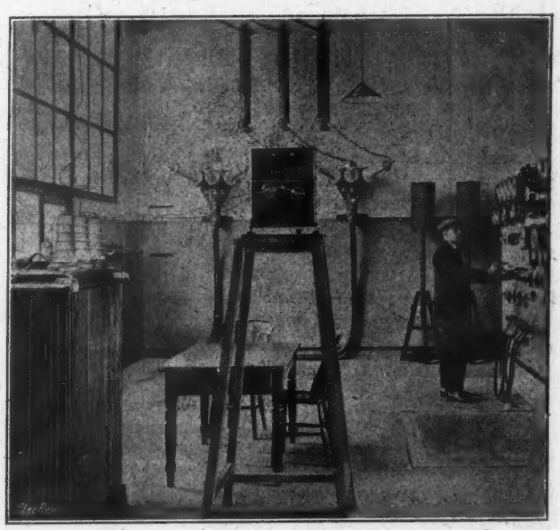
(*Concluded from page* 89.)

It is, of course, well known that our near neighbour France has for many years carefully fostered her agricultural resources, and, amongst other matters which have occupied attention in official circles, is the possibility of extending the use of electricity for agricultural purposes, largely with a view to helping out the scarcity of labour after the war. A good deal has already been done in this direction by the enterprise of French electric power companies, by the co-operative action of French farmers, and by a valuable measure of Government assistance.

In France there are extensive distribution networks, and electrical energy can be purchased cheaply enough on the line of transmission, but the problem there (as elsewhere) is to supply the farms situated at some distance from the transmission routes. Solely from the point of view of cost, it is impossible for the supply company to serve such consumers *as individuals*, but the difficulty has been overcome by a number of agriculturists co-operating in the provision of a distribution system, and, if necessary, of a generating station to supply it.

It was to facilitate the realisation of such co-operative schemes that the French system of collective agricultural credit was first established, and there seems to be no doubt that this system will play a very important part in future, and not only in France. Mutual agricultural credit was organised in France by the Act of November 5th, 1894, which created district banks for agricultural credit. It was laid down that the capital of these banks could only be found by subscription from members of agricultural syndicates, and one of the objects of the district banks was to make advances to the local banks of the syndicates. This excellent preliminary to the solution of the financial difficulties which are at the back of so many agricultural problems was followed by another law (March 31st, 1899), which placed an advance of £1,600,000 from the Banque de France at the disposal of the Government for application to loans (free of interest) to the district banks, in order that these in turn might render more effective assistance to the local societies. Still later, the law of September 29th, 1906, organised long-term agricultural credit, and authorised the Government to draw on the funds up to £1,600,000, and remit sums to the district banks, free of charge, for the benefit of agricultural co-operative societies seeking loans for approved purposes. Societies thus financed are required to repay the district banks by annual instalments over periods up to 25 years. Outstanding principal is subject only to 2 per cent. interest per annum. Advances to the local society in respect of agricultural operations or the purchase and installation of machinery, &c., are made by the district bank as the work proceeds. The total amount of the advances may not exceed twice the capital subscribed by the society to the local bank, and the capital itself is made up of shares, of which every member must purchase at least one. The shares bear interest at not more than 4 per cent.

Societies desirous, or formed with the sole object of establishing a central station to serve a group of farmers, or of purchasing energy in bulk from a power company, are admitted to the full benefits of the scheme of financial assistance outlined above, and are thus relieved of the immediate capital expenditure. Naturally, the societies



Pirelli-General Cable Works: High-pressure Testing Room.

have to pay, in the long run, the same amount (plus interest) as they would have to pay for a central station, or for a feeder and sub-station, if they paid outright in the first instance. This means that the cost per unit for electrical energy is relatively higher until the capital debt is discharged, but the burden of the latter is distributed over anything up to 25 years. The price per unit is at first such that the annual receipts provide for interest and depreciation on the loan, costs of working and maintenance, and, in addition, the accumulation of a reasonable reserve fund. After the loan is repaid, the price per unit naturally decreases very considerably. If the receipts

show a surplus, after making the above provisions, it is divided between consumers (who must all be members of the society), in proportion to their consumption.

There is no limit to the number of district banks which may be established, and at the end of 1913 there were 98 distributed all over France, so that co-operative agricultural societies could be founded and operated anywhere.

It cannot be too strongly emphasised that the obstacles in the way of really general utilisation of electricity in agriculture are those of finance and those of conservatism. The manufacturers can supply electrical equipment suitable for every farm need*, and agriculturists could, if necessary, obtain electrical equipment on easy terms by the co-operative society system, especially the larger electric motors (as needed for ploughing, threshing, &c.), which can only be used economically on a co-operative basis. At the back of such co-operative societies must be agricultural banks, with a measure of State support. Granted the organisation for financing co-operative societies there still remains the task of persuading agriculturalists to form them, and it will fall upon central station engineers and electrical manufacturers to boost the advantages of electric power in agriculture just as they do in its other industrial applications. In this special application, however, they might go further, not only overcoming the conservatism of farmers, but showing them how the financial problem may be solved by co-operation, and even assisting in securing the necessary organisation and Government support for co-operation.

It may be of interest to give a few particulars concerning a French limited liability co-operative society in the Roisel (Somme) sector, which has as its object the supply of electricity for agricultural purposes, or, more specifically, its object is "to facilitate agricultural operations by supplying electricity for all purposes," and, with this end in view, the society makes contracts and loans to secure the proper installation and use of apparatus for its members. The society has members in 36 communes, and is established, in the first place, for a period of 20 years. The original capital was £8,000, in 2,000 shares of £4 each, and this can be increased by decision of a general meeting, or it may be reduced (by not more than 10 per cent.) by calling in shares.

Each member must hold at least one share, £1 being paid on application and the remainder as and when demanded. Each share is indivisible, will not be redeemed at a premium, and will not bear more than 4 per cent. interest. A certain proportion of all fresh capital issued is reserved to old shareholders, the admission of new members is controlled, and any member may retire, or he may be expelled for a sufficient reason, so long as the capital is not reduced more than 10 per cent. by such action. Until all State loans have been repaid, the capital may not be reduced below that on which the loans were granted. Members retiring or expelled are bought out by the society (at not more than par), but they are still liable, to the amount of their former shares, for debts contracted by the society during their membership.

The administrative council of the society comprises nine members, each of whom holds at least 10 shares during his whole term of office, these shares being inalienable and deposited in the society's bank as a guarantee. The normal period of office is three years. The council is given full control over affairs of the society and, *inter alia*, it fixes the price of current and the conditions of supply once a year. Any or all of the powers of the council may be delegated by it to a working committee of three members. A technical director (possibly not belonging to the society) may be appointed to work under the council. In general meetings, five shares (£20) counts as one vote, but no member may exercise more than 10 votes. Consent of a general meeting is necessary in the case of proposed deals involving £4,000 or more, and in the case of work proposed to be done at a cost of £800 or more to the society. A valuable opportunity of furthering the aims and interest of the society is afforded by the annual meeting, for which one delegate is nominated from each commune. As regards the distribution of profits, any surplus after paying redemption and working expenses is taxed 5 per cent. to provide the statutory reserve; then 4 per cent. interest is paid to shareholders, and 10 per cent. of any surplus still remaining is placed to supplementary reserve, the balance being divided amongst shareholders. The reserve funds are not repayable to members under any circumstances; in case of liquidation any balance from reserve is to be applied to encouraging agricultural co-operation, or to other works of agricultural amelioration.

The constitution and aims of this society form a very good example of the businesslike yet sympathetic lines on which such a scheme must be operated if it is to succeed. Not the least pleasing feature of the society's statutes is the provision whereby non-members may have two lamps on practically the same terms as members. This rule reserves the benefit of wholesale electric lighting and of electric power to the members, without denying to "outsiders" the great convenience which even a couple of filament lamps may bring.

In concluding these remarks we may draw attention to two further matters which may have a considerable influence on the future development of rural electricity supply, viz., ploughing and transport. As most of us are aware, a revolution on a small scale is occurring in connection with ploughing—the oil tractor and plough which so many people scoffed at a few years back has, owing to war-labour conditions, been forced into use, and it is said that over a 100 firms are building suitable engines for ploughing purposes. This is a development which may as easily react in favour as against electric ploughing, if we choose to develop agricultural electricity supply on an extended scale. Given a shortage of labour, the farmer must adopt mechanically-driven ploughing and cultivating appliances, and that type which requires the least labour and least costly fuel, and is inexpensive in upkeep and most simple in operation, should appeal most strongly to him.

Of the three "power" systems in use, viz., the "cable," the "tractor" and the self-contained motor plough, we know from Continental and British experience,* that electric cable ploughing is a greater labour-saver, and less costly in plant and operation, than steam ploughing by cable; an American writer (Koester) some years ago gave the comparative capital costs of electric and steam cable plough tackles as $11,000 and $14-15,000.

The disadvantage cited against the electric tackle—that it is not self-propelled—could obviously be overcome.

According to an English writer on the general question of ploughing† a set of 14-H.P. nominal ploughing engines, with a six-furrow plough, can plough 20-25 acres per day, or cultivate 50-55 acres; in a season 3,000-4,000 acres are dealt with. Such a set is usually hired at 10s. to 12s. per acre, the farmer finding coal and water; it requires four men and a boy, also a man and horse for carting. The cable system allows of any practicable depth of ploughing, and the cables are good for 6,000-8,000 acres before renewal.

Obviously the high initial outlay is against the use of a steam-operated cable system by small or medium farms, unless they hire, in which case the time of use has to be arranged.

The less costly and more mobile oil tractor has been developed in a variety of sizes, ranging from 7 to 60 traction H.P. and from 15 to 120 B.H.P., and the 25-30 B.H.P. machine is suggested as suited to conditions in this country. The traction efficiency appears to be 50-60 per cent., but limits of 30-70 per cent. are sometimes reached; a Canadian test showed a weight of 535 lb. per B.H.P., and 61 per cent. of this delivered at the draw-bar when ploughing. It is interesting to note that the draft of ploughs in different soils varies from 227 lb. in loamy sand to 660 lb. in blue clay, with a furrow 5 in. deep and 9 in. wide, and that a 10-12 H.P. engine on a self-contained plough is considered sufficiently powerful for two furrows in medium land, the machine weighing about 1 ton, and ploughing about 3 acres per day. These figures should be of interest to electrical men who are considering rural supply work, because the battery-plough and battery-tractor are obvious possibilities with an intensively developed farm-electric supply system. This also applies to the question of transport, which is bound up with the employment of the electric tractor, which is already in considerable favour for industrial use. But there is also to be considered for large farms, or for co-operative working, the use of narrow-gauge light railways with battery or trolley tractors, such as have, in fact, been employed on the Continent, and with which our own Light Railway Commissioners were, according to a writer in the *Times*, originally intended to deal.

* Many of the existing standard agricultural machines operate at too low speed for efficient electric driving. This is, of course, due to these machines having been developed for hand operation or for slow-speed belt driving, and there is no reason why modified machines should not be built for direct coupling to high or medium-speed electric motors. Co-operation is required between electrical manufacturers and makers of agricultural machinery.

* "Electric Ploughing," Elec. Rev., February 11th, 1916.

† "Mechanical Aids to Farming," *Commercial Motor*, July, 1916.

It is obvious that rural transport will have to be reorganised in the future, and, given the necessary supply facilities, there is no obvious reason which electricity should not play a prominent part in connection with it.

ERRORS OF DIRECT-CURRENT AMPERE-HOUR METERS.

By G. W. S.

The present article is an attempt approximately to investigate, from a theoretical standpoint, the errors of direct-current ampere-hour meters. The shapes of the curves of both mercury and commutator meters are well known, but it would seem only empirically. An investigation of these curves from a theoretical standpoint is not only interesting, but valuable, as it will throw considerable light on their nature, will point out a rational method of testing the two types of meters, and, incidentally, will explain the remarkable difference in the performances of meters of the mercury and commutator types.

Considering first an ideal meter of either type, without solid or fluid friction, in which the same field is used for braking and driving, we have, C being current, B flux, ω angular speed, a and e constants, equating torques

$$e\,\omega\,B^2 = a\,C\,B,$$
$$\omega = a\,C/e\,B,$$

showing that the speed of a meter for a given current is inversely proportional to the flux. This is now generally known, but it is interesting to recollect that in a descriptive pamphlet of a well-known meter, published not many years ago, it was stated that, as the braking and driving fluxes were identical, an alteration in the strength of the magnets would not affect the accuracy of the meter.

The case of a meter with solid friction only may now be considered. The fundamental equation now becomes, f being frictional torque—

$$a\,B\,C = e\,B^2\,\omega + f,$$
$$\omega = a\,C/e\,B - f/e\,B^2.$$

The error is accordingly $-f/e\,B^2$, and it is interesting to note that this varies inversely as B^2, emphasising the advantage of powerful magnets.

Consider now the meter with the armature at rest, and with a current infinitesimally less than starting current passing. We shall now have—

$$0 = a\,C_s/e\,B - F/e\,B^2 \text{ and } F = a\,B\,C_s,$$

C_s being starting current and F being standing-still friction.

It is difficult to estimate the ratio between F and f, the friction when the rotor is moving. It is quite probable that in the case of mercury meters, even at minute speeds, the armature has a tendency to be lifted off the bottom jewel, the friction thereby being very considerably reduced. In the case of a commutator meter, there will be no such tendency. As a rough approximation, $F/f = n$ may be taken as 3 for a mercury meter and $1\frac{1}{4}$ for a commutator meter.

We have accordingly, $f = a\,B\,C_s/n$.
The error can now be written, $-a\,C_s/n\,e\,B$.
The percentage error η is therefore, $-100\,C_s/n\,C$.

This error, it must be noted, is the difference between the actual and ideal speeds of the meter. It is not the same as the inaccuracy of registration, for, as is well known, the wheel work of the counting train of a meter is so adjusted as to make the algebraical average of the various inaccuracies as near zero as possible.

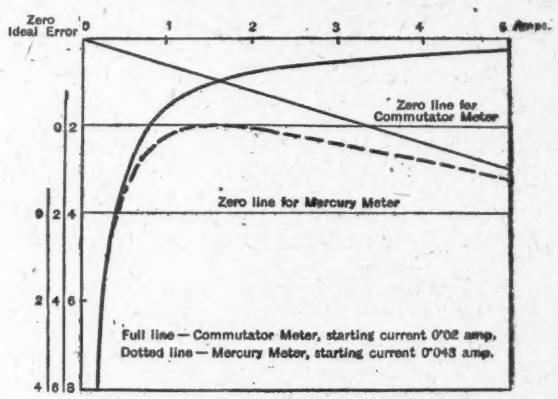
The results obtained above apply with close approximation to a commutator meter, and also to a mercury meter at low speed. They demonstrate that the curve of a meter in these circumstances is a rectangular hyperbola, and that the performance of the meter depends upon the starting current and the ratio of stationary to moving friction.

To take a numerical example, with a commutator meter having $C_s = 0{\cdot}02$ ampere, $n = 1\frac{1}{4}$, the percentage error at $\frac{1}{4}$ ampere will be $-6{\cdot}4$. Since the meter will probably be adjusted to read 2 per cent. fast at ideal speed, the inaccuracy will be, at $\frac{1}{4}$ ampere, 4·4 per cent. slow. With a mercury meter, C_s being 0·03, and n being 3, the percentage error will be -4. As the ideal speed will, for reasons to be explained later, probably be about $3\frac{3}{4}$ per cent. fast, the inaccuracy of the meter at $\frac{1}{4}$ ampere will be $\frac{1}{4}$ per cent. slow.

It may occasionally happen that a mercury meter will give a satisfactory test at low load with an unsatisfactory starting current, this indicating that n has a higher value than 3. In such a case the rotor will usually be found to be out of truth or improperly balanced, a state of affairs that needs correction. The suitability of starting current as a criterion of the accuracy of a meter is not, therefore, vitiated by such an example.

The case of a meter having both solid and fluid friction has now to be considered. The simplest way to deal with this problem is to assume that fluid friction introduces an error proportional to ω^2. Since ω is very nearly proportional to C at the higher speeds when fluid friction ceases to be negligible, we may consider this error to be proportional to C^2.

The error may be written $-f/e\,B^2 - g\,C^2$, g being a constant, percentage error $\eta = -100\,C_s/n\,C - m\,C$, m being a constant. The shape of the curve is now altered. There



Errors of D.C. Ampere-hour Meters.

is now a minimum arithmetical error for a finite value of C. The curve can be constructed by adding the ordinates of the original curve to those of a straight line $x = m\,C$. The shape of the curve is very little modified for the lower speeds of the meter.

The result of the correction for fluid friction by weakening the flux by an amount proportional to the current may be investigated as follows :—

The speed, neglecting errors, without the correcting device is,

$$\omega = a\,C/e\,B,$$

The increased speed due to correction—

$$\omega' = a\,C/e\,(B - S\,C), \text{ S being a constant.}$$

We therefore obtain very approximately, S C being small—

$$\omega' - \omega = a\,S\,C^2/e^2\,B^2.$$

The result of the correction as regards the errors of the meter is of the second order of smallness, and may be neglected. As the result of the correction of the meter is proportional to C^2, its effect is to diminish the constant m in the equation giving the error of a mercury meter, and in no way to alter the nature of the curve. By increasing the number of turns in the correcting coil, it will be possible almost exactly to counteract the effect of fluid friction, or even to over-compensate the meter. This is rarely done, and it will be explained that it is advisable slightly to under-compensate the meter.

The accompanying diagram will make these results clear.

The full-line curve is a rectangular hyperbola, and represents the performance of a commutator meter. The straight line represents the effect of uncompensated fluid friction, and the dotted curve represents the effect of both solid and fluid friction as found in a mercury meter. A consideration of these curves will show very clearly why a mercury meter gives greater accuracy at low loads than a commutator meter. With a commutator meter the full-load speed is relatively the greatest, and the zero inaccuracy line has so to be adjusted that at this load the meter is not more than 2 per cent. fast. With a mercury meter, the speed at full load is relatively much smaller, and the zero inaccuracy line can be adjusted to a lower position, as shown. It will be seen from the diagram that although the ideal error of the two meters at ¼ ampere may be the same, the inaccuracy of the commutator meter will be 2 per cent. greater than that of the mercury meter. It will also be clear that it is advantageous for the curve of the mercury meter to drop slightly at the higher loads, as this allows the zero inaccuracy line to be shifted to a lower position than otherwise.

The equation for the error of a mercury meter may be written—

$$\eta = -(p/c + m\,c);$$

we easily obtain by differentiation that the smallest arithmetical error occurs when $c = \sqrt{p/m}$. It therefore follows that if from observed values of c and η, p and m can be calculated, this value of c can be obtained. This value can, however, be ascertained by trial for different types of meters, and will be found to be fairly constant for each type, it being remembered that c is the current in the bath of the meter.

It therefore follows that the three criteria necessary to determine the accuracy of a mercury meter are tests at full load, at load of minimum arithmetical error, and starting current. If these criteria are satisfactory, other tests are superfluous. In the case of a commutator meter two tests are sufficient, starting current and full-load speed.

HIGH-SPEED TELEGRAPHY.

AN important report was issued last week by the Committee appointed by the Postmaster-General at the end of 1913, to consider the position of high-speed telegraphy for the information of the Post Office. It states that when the only high-speed systems available were the quadruplex Morse and the Wheatstone, neither of which was satisfactory, a sufficient number of wires was provided to carry the traffic with low-speed apparatus, and as the volume of telegraphic traffic has been at a standstill for some years, there has not been an urgent demand for the increased use of high-speed apparatus. It would not be desirable to take down existing wires in order to justify the application of high-speed apparatus to the remaining wires. A reduction in the number of telegraph wires has, however, been effected by converting some of them into trunk telephone wires, and in the development of the telephone service this policy of conversion must continue to be followed. In this way the economical multiplication of high speed telegraph circuits can be effected. The economy will be twofold, first, by the saving of wires, and secondly, by the increased output per operator which is yielded by certain of the high-speed systems.

In the Post Office service the duplex method of working is normally adopted on all lines where the traffic justifies it. A duplex Morse circuit has a speed of 30 words per minute in each direction, and a total carrying capacity of about 60 words per minute. All systems which provide a greater output than this are classed as high-speed systems.

Of these there are two classes, commonly called automatic and multiplex. The first provides an actual higher speed of working with a limit of two channels in opposite directions; the other class distributes the higher speed of the circuit among three or more operators. Of the first class, the Wheatstone, an automatic high-speed Morse, is the typical instrument; of the second class, the Quadruplex, as applied to the Morse system, and consisting of two duplex circuits on one wire, is typical. A departure from the Morse system was adopted in the shape of the Baudot telegraph system; this is worked on the multiplex principle, *i.e.*, any even number of channels up to 12 can be provided on a single circuit, working simultaneously and equally divided between the two directions.

Numerous experiments have been made by the Post Office with various types of apparatus designed to improve the service. Many of the instruments that were the subject of evidence before this Committee had undergone actual trials before its appointment. Although the carefully designed series of tests which it was hoped would illustrate and support the Committee's recommendations could not be proceeded with, owing to the outbreak of war, the ample information available has enabled it to make certain definite recommendations without prejudice to further developments which may arise after the war.

Amongst the systems which have been investigated during the last 30 years, the following are still in use by the British Post Office:—The Creed receiving perforator, whereby ordinary Wheatstone signals are utilised for reproducing a Wheatstone slip, and thus enabling a message to be retransmitted without perforating fresh slip by hand (45 in use); the Murray multiplex (type printing on ordinary telegraph forms), in which a perforated slip is prepared by means of a keyboard perforator and passed through a transmitter, the signals being sent to line *viâ* a distributor which connects the line in turn to each of the transmitters, a synchronised distributor at the receiving end distributing the received signals to the printers (one double duplex, London-Manchester); Gell keyboard perforator, which prepares Wheatstone slip with electromagnetic punches (over 150 in use); the Creed printer, in which perforated Wheatstone slip at the receiving station controls a pneumatically operated typewriter (40 in use); the Booth-Baudot duplex (six inland circuits); the Siemens automatic (type-printing), actuated by perforated slip, with a transmitter, synchronised distributors, and an electromagnetic typewriter (one duplex circuit, London-Liverpool); the Kleinschmidt keyboard perforator, similar to the Murray perforator; and the Western Electric multiplex (type-printing), using perforated slip, distributors synchronised by the ordinary signalling currents, and a typewriter (one quadruple duplex circuit, London-Manchester). When the last statistics of the International Bureau of the Telegraphic Union were issued, the United Kingdom had 11,061 low-speed instruments in use, and 670 quadruplex, 795 Wheatstone, and 22 Baudot high-speed instruments; France, with 12,714 low-speed instruments, had 1,155 sectors on the Baudot system; Germany, with 12,455 low-speed instruments, had 30 Baudot, 27 Wheatstone, one Murray, and 16 Siemens high-speed instruments; Italy, with 15,514 of the former, had 19 Wheatstone, 152 Baudot, and four Rowland sets; and Russia, with 9,796 of the former, had 121 Wheatstone, 115 Baudot, and three Murray high-speed instruments. Other countries showed far less development in high-speed telegraphy.

The Committee held 28 meetings, and received evidence from inventors and other experts regarding the various systems. The question resolved itself into a rivalry between automatic high-speed systems on the one hand, and the multiplex on the other, though the inventions of Mr. Creed and the advent of various keyboard perforators had affected the situation of the former, and the inventions and writings of Mr. Murray had intensified interest in high-speed telegraphy generally. But three new and important systems were brought to the notice of the Committee, namely, the Siemens automatic printing telegraph, and the multiplex systems of the Western Electric Co. and the Automatic Telephone Manufacturing Co.

The Morse code employs groups of symbols of varying lengths for the different letters, while in the five-unit code permutations of positive and negative impulses, always five in number, are employed; the former is used for Wheatstone working, but most of the multiplex and automatic systems use the latter, which for printing telegraphs has substantial advantages.

The question whether Wheatstone working should be employed systematically during particular hours each day, or only spasmodically at times of pressure, has been a much-debated one ever since the Wheatstone patents came into the possession of the Post Office, and the system still presents problems in organisation, though these have been modified by the introduction of the Creed receiving apparatus, which produces punched slip instead of the Morse tape, enabling the message to be translated into type letters by the Creed printer, or retransmitted without translation. But even with the addition of the Creed inventions, the Wheatstone system is not a desirable one for commercial telegraph work, as the operators are not in direct communication, and there is difficulty in obtaining corrections. Multiplex working has the advantage of placing the operators in direct association with one another, exactly as if they were working low-speed duplex, so that any apparent error or failure can at once be rectified. Moreover, the working speed of the printers does not exceed 120 words per minute, and this rate cannot be maintained continuously. The greatest objection to the extensive adoption of the Creed instruments is their cost to purchase and maintain. The Gell keyboard perforator for preparing Wheatstone slip at the sending end of a circuit is one of the most efficient instruments that the Post Office has tried for this purpose, but costly. Mr. Gell has also invented an automatic switch to connect two or more Wheatstone transmitters direct to line in turn, saving line, time, and labour, and this is recommended for further trial. The Kleinschmidt keyboard perforator is cheaper than the Gell, and works satisfactorily. The Siemens-Halske is a direct printing system, with keyboard perforators at the sending end; at the receiving end, the received impulses act directly, without the interposition of a perforated slip, on the printing mechanism.

(To be concluded.)

D

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

White's Patent Corrosion-Proof U-Seal Fittings.

We have from time to time noticed the growth of the series of corrosion-proof fittings for use in conjunction with cab-tire-sheathed cables in bad situations, which has been developed on the basis of the patent of Mr. J. C. White, electrical engineer to the St. Helens Cable and Rubber Co., Ltd., Warrington. The list has steadily lengthened, and now provides for the bulk of the requirements of chemical works, explosives factories, &c., where extreme precautions are necessary to guard against the corrosion of the fittings and lamp-caps by acid fumes, accidents from shock, and ignition of explosive gases; our congratulations are due to the inventor and his firm on the ingenuity of these devices, representing a great advance on the original patterns, and the excellence of the materials and workmanship embodied in their construction.

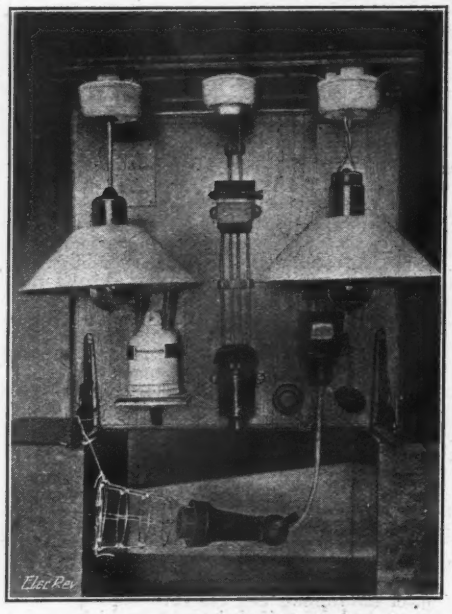


Fig. 1.—White's Corrosion-proof Fittings.

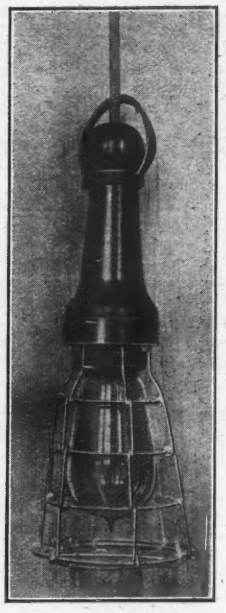


Fig. 4.—Portable Hand-lamp.

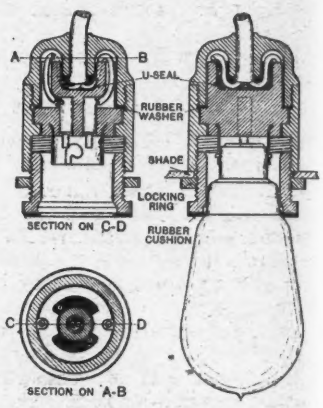


Fig. 5.—Sections of Pendant Lampholder.

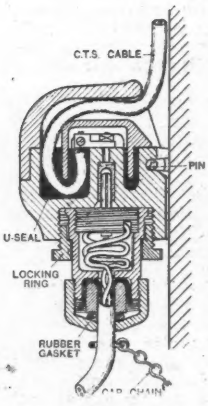


Fig. 2.—Section of Socket and Plug.

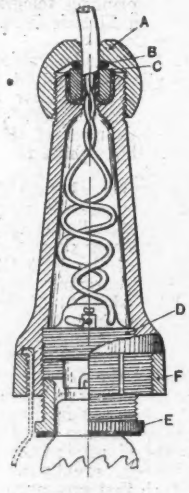


Fig. 3.—Section of Hand-lamp.

Fig. 6.—Socket and Plug.

Fig. 7.—Plug with Cap on.

We illustrate in fig. 1 a showboard comprising the apparatus referred to, among which are several new items of which particulars will be of interest to our readers. Fig. 2 shows in section a corrosion-proof wall socket and plug, composed mainly of ebonite. The socket is attached to the wall by screws through lugs, and is provided with the U-seal filled with compound which characterises nearly all these fittings; after wiring with "C.T.S.," either single or loop-in, which is an easy matter, the compound is poured in, the connections are covered with an ebonite diving-bell cap, and a hood is slipped on, and locked with an ebonite pin. The socket faces downwards, so that no liquid can rest or accumulate on the contacts, and when not in use the opening is closed with a screwed cap. The plug is shown in section in the same view; it is provided with a rubber gasket fitting round the flexible C.T.S. cable, and a barrel containing slack leads, which are attached to the contact pins. An ebonite locking ring secures the plug when in position, and is closed by a cap to protect the pins at other times. The strain is taken off the leads inside the plug by an ingenious and effective method, the tough sheathing being split and turned back over the U-seal, and gripped between the cover and the barrel as shown, the rubber gasket being simultaneously squeezed, so as to render the whole fitting water-tight.

The complete plug and socket, and the plug alone with its cap on, are shown in figs. 6 and 7.

A section of the portable hand-lamp is given in fig. 3. At the upper end the flexible cable is gripped without pinching the conductors, as explained above, and the connection is made water-tight by the cap A, gasket B, and ring C. Slack leads within the ebonite handle connect to the lampholder D, which is of the simplest possible construction, and easy to wire. When the lamp is in place, the collar E, which carries an elastic ring, is screwed back to lock the lamp and make a water-tight joint with the bulb. The guard, of tinned iron wire, the ends of which are bent to fit the recesses shown, is then put in position and locked securely with the collar F. The whole forms a very substantial fitting, with not a single metal screw except in the terminals, and offering no possible opportunity for any exposed metal part to become alive. A leather loop, containing no metal parts, is attached to the handle. Fig. 4 shows the complete fitting.

Fig. 5 gives sections of a corrosion-proof pendant-holder with U-seal, which explains itself, in the light of the foregoing remarks, except that the cord grip consists of a wedge of wood inserted in the end of the cable to expand the sheathing, and a rubber washer closes the space containing the terminals. The shape of the U-seal is seen in the sectional plan.

Lastly, fig. 8 shows a "Goliath" half-watt lampholder in earthenware; in this case the terminals, which are arranged for

loop-in wiring, are enclosed in a chamber, which is afterwards filled with melted compound through a hole in the cap, which is finally closed by a screw plug. This holder is unaffected by the heat from the lamp, by acid vapours, &c., and a nut with an

Fig. 8.—Parts of "Goliath" Lampholder.

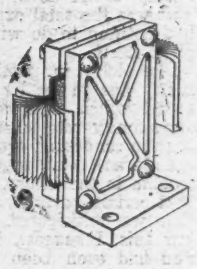


Fig. 9.—Precision Condenser.

asbestos cushion, which is screwed down on the glass, prevents access of fumes to the metal parts. It will be seen that a very complete and practical set of fittings has been developed, and the samples before us show that in construction and material they are all that could be desired.

Precision Condensers.

Edmund B. Wheeler and Morton Sultzer, of East Orange and New York respectively, propose in Patent No. 1,200,063, a method of manufacturing electric condensers which not only permits of adjusting and maintaining the capacity to a high degree of accuracy, but which also allows of a very rugged construction. Heretofore, in condensers of the stack type, it has been customary to use tinfoil between successive layers of insulation. In view of the very low tensile strength of tinfoil, it is proposed that part of the tinfoil sheets be replaced by copper or aluminium foil, and it is found sufficient to have the last few sheets on each side of the condenser formed of this stronger metal. Clamping plates are used for compressing the sheet material to a high degree. It is found that the use of a few sheets of conducting material of high tensile strength in these condensers permits an accurate adjustment of the capacity of the condensers as a whole. This adjustment is accomplished by having the capacity at first a little larger than desired, and then pulling out sheets until the desired capacity is obtained. When this stage of the manufacture has been reached, the condenser is placed in a suitable furnace and is maintained at a high temperature to remove any traces of moisture and excessive quantity of air. The condenser is then dipped into a molten mass of sealing mixture. Its construction is shown in fig. 9.—*Electrical World*.

Battery Ignition for Petrol Motor Vehicles.

A new departure in current-distributor breaker mechanism in connection with battery ignition on petrol motor vehicles has recently been introduced by the Pittsfield Spark Coil Co., of Pittsfield, Mass., U.S.A. As will be seen from the accompanying drawings, which represent in an exaggerated form the stages of the action of the device, the arrangement, notwithstanding the unusual action, is extremely simple. The essential feature is the employment of two stout spring-steel blades A and B—one being slightly longer than the other—each of which, it will be noticed, carries a contact point. The cam is shown as being in the form of a square with

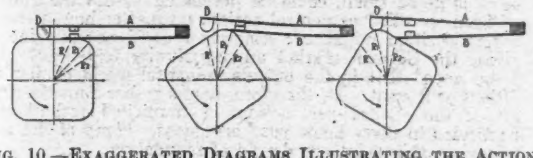


Fig. 10.—Exaggerated Diagrams Illustrating the Action of the Pittsfield Positive Make-and-Break Mechanism.

rounded corners, being intended for a four-cylinder engine; it would, of course, be hexagonal for a six-cylinder engine, octagonal for an eight, and so on.

With the cam in the position shown at the left, the ends of both the blades are resting on the cam, but the platinum points are not in contact. As the cam turns, it first lifts the blade B, bringing the platinum points together. This causes the blade A to be lifted to the position shown in the centre diagram, thus keeping the platinum points together with a firm pressure. Immediately the point of the cam strikes the extremity D, the circuit is broken, and thus the cam mechanically "makes," and immediately afterwards mechanically "breaks," the circuit. Since both the make and the break are made by the cam, both are equally positive, and the contact can neither fail to make nor to break, the action being entirely independent of the strength of the springs. Other claims made for the arrangement are that, owing to the short duration of the contact, the current consumption is small, thus reducing the demand on the battery, and that the positive action permits the distributor to operate with perfect regularity at speeds in excess of the highest engine demands.

The distributing sets to which the new make-and-break device is fitted are made up into units 6 in. long × 3½ in. diameter, the unit including the coil and condenser, so that the only external wire is a single lead to the battery, in addition, of course, to the high-tension leads to the sparking plugs in the engine. The coil and condenser are also so fitted that they can readily be removed in one piece, and so give access for any adjustments of the interrupter mechanism.

LEGAL.

Cedes Electric Traction, Ltd.

In the Winding-Up Court, as briefly reported in our "Notes" last week, an application was made to Mr. Justice Astbury to stay proceedings in the winding-up of Cedes Electric Traction, Ltd., in order that the Board of Trade should have an opportunity to decide whether they desired to exercise their rights and duties under the Trading with the Enemy Act, the allegation being that this was a company under the control of alien enemies with debts owing to English creditors.

In giving judgment, his Lordship said that the company was registered in 1910 and was said to be under the control of enemy subjects, and it was alleged that its share and debenture-holders were alien enemies. The summons to stay proceedings was by an English creditor, who obtained judgment against the company in 1915 for £1,500. Subsequently in the same year the company issued £3,000 worth of debentures, and in December, 1915, a winding-up petition was brought by another English creditor. In January last year the Trading with the Enemy Act was passed, and in April, 1916, the petition came on for hearing, and the usual winding-up order was made without any of the facts that he had stated being brought to the attention of the Court. It appeared that there were a number of unsecured English trade creditors of the company. A foreign enemy now claimed to be a creditor for a very large sum which, if the debt existed, would absolutely swamp the assets so far as the English creditors were concerned. The business was now being carried on by a Receiver for the debenture-holders, who were said to be alien enemies. The application to stay the winding-up temporarily was to give the Board of Trade an opportunity of considering whether they wished to act under the legislation he had referred to. Subject to proper undertakings being given by the applicant, he thought the application ought to succeed. and he proposed to stay the winding-up for six months to give the Board of Trade the opportunity already mentioned. It was stated that the undertakings would be given.

Breach of Electricity Regulations.

A sequel to the death of Thomas Bennett, of Peak Dale, Buxton, employed by the Buxton Lime Firms Co., Ltd., came before the Buxton magistrates on Saturday, the company being charged with having failed in two instances to comply with the electricity regulations made under the Factory and Workshops Act. Last September Bennett, who was employed as a wagoner, was found lying dead on an iron pipe near a tunnel, fearfully burnt on several parts of the body. The pipe contained a cable used for lighting purposes. Mr. W. H. Grenard, of the Home Office, instructed by the Public Prosecutor, appeared for the prosecution, and Dr. Eastham was for the defence.

Mr. Grenard stated that the electricity passed along a power wire and a lighting wire; they went partly through a metal pipe. The question of lighting had nothing to do with the case. On September 13th Bennett was missed, and an alarm was raised. He was found dead, with his left hand and arm on the pipe through which the lighting current ran. If the pipe had been properly earthed in accordance with the regulations, death would never have occurred.

Dr. Eastham submitted that the case was misconceived. The man was not killed in the tunnel. He had to climb up a 4 ft. 6 in. wall, and had gone a yard or two up the embankment. It was not a thoroughfare. The pipe was placed in an inaccessible place, and his clients thought it was in such a position that no one could get at it, and no one's duties took him there. He submitted that the case for the prosecution had not been established, and that the company were not responsible for contributing to the man's death.

The Chairman (Mr. T. H. Lowthian) said the Bench were unanimous in the first case, and imposed a fine of £10; the second case would be dismissed on payment of costs.

Broken Trolley Wire.

At the Belfast Recorder's Court, James Dwyer and his wife claimed damages from the Belfast Corporation for injuries received in October last through the falling of a trolley wire while they were standing at the corner of a street. His Honour awarded £5 to Dwyer and £4 to his wife.

BATTERSEA BOROUGH COUNCIL *v.* JUCHAU.

AT the Wandsworth County Court, before Judge Harrington, on Monday, the plaintiffs brought an action against George Juchau, now of 49, Northcote Road, to recover £14 1s. 4d. for the installation and hire of three electric lanterns outside 40, Northcote Road.

MR. E. T. DALE, for the plaintiffs, said the case was brought as a matter of principle. The lanterns were supplied and erected under an agreement for their use for three years, but owing to the police regulations the lights were in use only a few months, and though under the agreement the Council had the right to charge the full amount, they offered a reduction of 75 per cent. to all customers. Defendant never availed himself of the offer. He was charged rent till September, 1915, and, in addition, the actual cost of installation.

F. THWAITES, a clerk in the Council's service, produced the agreement dated July 14th, 1914. Apart from a small meter rent, the hire agreement was 13s. 9d. per quarter, or £2 15s. a year for each lamp.

DEFENDANT, in reply to the Judge, said he was an Englishman. He had only been able to use the lights three or four days when war broke out. Therefore he did not think he owed the money, as he had not had the light.

JUDGE HARRINGTON said he understood defendant was charged with the expense of being supplied with the fittings. He considered the Council had acted very considerately in making the reduction they had.

MR. THWAITES said the full amount would have been £24 18s. 9d., but defendant was only charged with the cost of the installation. Defendant was still carrying on business in the same road, having changed from one side to the other, but he had never determined his contract. The undertaking was to use the light for at least 650 hours per annum.

DEFENDANT agreed that he had entered into the contract, and had paid £2 3s. 3d. under it. The three lamps were outside the shop, but he had not had the light, and he was not going to pay. He had never asked the Council to take back the lamps.

MR. DALE referred to the case of the Leiston Gas. Co. *v.* Leiston-cum-Sizewell Rural District Council, a similar action, where it was held that the contract held good. In this case the amount would have been £8 6s. 10d., had the defendant been reasonable, but it was now over £14.

JUDGE HARRINGTON said it was quite clear from a decision in a similar action, which was upheld on appeal, that he would have to decide against defendant, though it might seem a hard case. He gave judgment for the amount claimed, with costs.

RUGBY URBAN DISTRICT COUNCIL *v.* SMITH.

AT the Rugby Police Court, last week, Hugh Leslie Smith was summoned by the Urban Council for feloniously using electricity between August 1st and October 15th last year.

In November, 1913, defendant applied to have the electric current installed at his house for power and heating purposes only, but when an official visited the premises on October 16th last he found wiring for lighting purposes had been put up in practically every room, and that lamps of 60 or 80 C.P. were in use; also that in an attic used as a workshop there was a lamp of 300 C.P. The charges for current for heating and power purposes at Rugby were respectively 1½d. and 2d. per unit, as against 4½d. per unit for lighting. It was also found that behind a picture in the hall of the consumer's house the cable had been bared for a space of 1½ in. and prepared for making connections; and that the seal of the fuse box had been broken, the Council's fuses taken away, and others of a stronger and different make put in, by which means it was possible to get a great amount of current without it having passed through the meter at all.

Defendant pleaded guilty to the charge, but said the large lamps were used for warming the rooms only.

A fine of £10 and costs was imposed, the Chairman (Mr. T. A. Wise) remarking that he was sorry to find a man in defendant's position guilty of such a mean fraud.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

British v. German Manufactures.

Your leader appearing in the current issue on preference for British manufacturers has brought the previous report on breakdowns to German plant to my notice again, and, without any desire to take up too much of your valuable space, I should like to explain the precise position in regard to the alleged Newport breakdown, supplementing it by a few comments on your more recent leader.

I am not aware how you obtained your information regarding the Newport plant. Had you communicated with me on the subject I should have been pleased to give you the fullest information. Presumably, you extracted the information from the copy of the annual statement of accounts and report sent you in the ordinary course. In that report it was mentioned that a 3,000-KW. A.E.G. turbo-alternator had been out of commission for five weeks, due to breakdown, *including the annual overhaul.* These latter words you carefully omitted. The reason why no detailed information was given in the annual report was that it was not desired to again refer to an alleged regrettable error which had been fully dealt with at the time by inquiry, and regarded as closed.

The actual facts are as follows:—The plant was installed in 1913, being put into commission on December 17th, since when it has practically run continuously, that is to say, day in day out, and for the greater portion of the time dealing with the major part of the total output. No single defect or trouble had occurred with it up to the time of the breakdown above referred to. On that occasion, apparently, the auxiliary oil supply used in starting up the set was not in operation, with the result that before the set reached full speed the centre bearing heated up, running the metal sufficiently to let down the shaft on to the labyrinth glands. This was the total extent of the damage done, and, obviously, had nothing to do with the design or the construction of the plant itself.

The delay in putting the plant into service again was partly due to the fact that new labyrinth glands had to be made, which occupied a considerable time, and further, the opportunity was taken to make a thorough overhaul, including the condenser equipment.

I am not at all suggesting that there is not a possibility of trouble in the future. Careful observation leads me to think that certain parts of the turbine will require renewal earlier than was anticipated, due to causes of a metallurgical nature; but this, I suggest, is by no means an uncommon feature, and had even been met with in the case of British-built turbines.

I do not propose to pursue this particular case further; but in regard to the general statement contained in your report as to the defective design and construction of certain German-built plants, these were purchased by Britishers, presumably with their eyes open, and on the advice of some of the most eminent consulting engineers in this country, and in many cases purchased, not by much-maligned municipal authorities, but by private limited companies, where certainly the question of price could hardly have been the ruling factor. Moreover, unfortunately, I believe much British plant has suffered from the same lack of experience as the German: it would, for instance, be interesting to know how many British-built turbo-alternators were out of commission in 1913 alone due to breakdown. I do not think that British manufacturers, as a body, would exactly care to see a published list.

I am not for one moment suggesting that, therefore, British plant is not superior to German-built plant. We have all, no doubt, got decided opinions upon this, both in regard to practical design and construction, and workmanship in erection, the latter a most important factor; but to pick out a number of isolated cases of breakdown and to hold them up as generally condemning any particular country's manufactures seems to me illogical.

Incidentally, if the particulars as set out by you are typical of German plant, there is, I suggest, a direction in which the outlook of the war for this country and her Allies is most hopeful, for there is evidently not only the attrition of manpower and economic attrition working in our favour, but, further, the attrition of machinery assisting us; for it can surely only be a matter of time before the major portion of German plant within the German Empire will have broken down under the excessive strains imposed upon it, and they will be unable to continue the manufacture of munitions in a sufficient quantity, being too busily engaged upon the repair of the driving plant.

Turning to the leader in your current issue, one is glad to note a prominent technical journal placing to the fore the question of the position of British manufactures after the war. A careful perusal of your leader, however, leaves the impression that your underlying political tendencies have been allowed to prejudice your better judgment.

There can be no engineer in the country to-day who would, if he could possibly help it, place an order after the war for any single item with a German company if a similar article, be it large or small, could be purchased within the Empire, or from an allied or neutral nation, no matter how attractive the proposition might be; certainly I could not imagine any giving the German market an opportunity to tender? It is to be hoped that in the outside industrial world similar conditions will exist. It, therefore, seems rather unnecessary to attack the alleged past actions of municipal authorities in particular to carry home your argument. Many of the statements on this point are devoid of foundation.

It is easy to be wise after the event; but who in the early summer of 1914 would have questioned the propriety of giving the German market an opportunity to tender? It is extremely unfair, therefore, to attack to-day the general business policy pursued in pre-war times.

But why particularly single out public authorities for attack and make little reference to private limited companies? It is common knowledge that some of the biggest British contracts placed in Germany were given by private companies.

Your suggestion that deputations to the Continent had anything to do with the contemplated, or definite, placing of contracts abroad is more in keeping with the hysterical vapourings of certain sections of the non-technical Press. Contracts were placed abroad because it was a sound commercial proposition to do so under the then existing conditions. That such

conditions should not be permitted to exist after the war goes without saying; how to ensure such safeguards as will effectively prevent it in the future is a matter for deep consideration, primarily and essentially a political and economic question; that it cannot be divorced from politics appears self-evident from your leader.

Tariff walls alone will never secure to this country the requisite safeguards, and there is always the danger that ultimately they will re-act prejudicially against all sections of a community, and the consumer in particular. Much more is necessary: A more intensive culture in the form of higher technical education, made compulsory, if necessary, specialised development and elaborate research work, particularly in the fields of chemistry and metallurgy, supported by generous contributions from the State, and, preferably, the inauguration of national institutions for such purposes. It is in this direction that engineers can best help, leaving the political and economic considerations in the hands of Statesmen.

Regarding labour and wages conditions, how are these to be regulated in the manner you indicate? They vary considerably in different parts of this country, and enormously so as between this country and our Colonies, but I take it the latter will certainly be given free trading opportunities within the Empire. Further, the municipal trade-union and fair-wages clause does not require a firm to pay the rate of wages in force within the particular municipal area, as you seem to imply. It is only required that the manufacturers shall pay the rate of wages current in their own district; it would be difficult to suggest a fairer arrangement.

Take the case of the allied and neutral nations, *i.e.*, France, Italy, America, or Switzerland, more particularly the former: Is it to be suggested that they should be debarred from entering into our home markets and benefiting from the total exclusion of Austro-German competition? Yet, how are wages conditions in these countries to be co-ordinated with ours? As a rule, in the engineering industry the rate of wages and conditions of labour in continental countries are, generally speaking, lower than in this country, and much lower than in the Colonies, but it is certainly to be hoped that, for this reason, neither our Colonies, nor our Allies, will be unduly penalised, but will be given free and ample opportunity to enter into vigorous competition with the British manufacturer; nor will it be any disadvantage to the purchaser for them to do so, but rather an advantage. As to why this should be so, you throw out a very plain hint when you state that, "What we have to guard against if we are to carry with us the co-operation of the public authorities is the temptation to raise our prices to such an extent as to play into enemy hands." Precisely; in truth may one say: *Rem acu tetigisti.* Have we here an indication of the underlying future commercial policy of British manufacturers, particularly in the electrical industry?

It is quite obvious that the total exclusion of the Austro-German market might provide a splendid opportunity for the exploitation of the British purchaser, to the advantage of the British manufacturer.

Anyone who has had an opportunity of visiting Germany and gaining even a superficial insight into the internal economic conditions and commercial policy, cannot fail to have observed how the German purchaser has been exploited, to the advantage of the German manufacturer, who has at the same time been able to carry on his peaceful penetration in foreign markets. It is well known that the German purchaser in the past has had to pay anything up to 20 per cent. more than he should have done for German-built machines in order that excess profits might be used to compete in and undercut the foreign market. Judged by our standards, it may seem a very immoral policy; but this would not seriously concern the apostles of German Kultur, who have reduced such methods to a scientific system, fostered and taught by their professors and intellectuals, and Jewish financiers, and supported in a practical manner by State subsidies. It is to be devoutly hoped that the British purchaser will not permit himself to be exploited in the same way in this country, not even in order that the British manufacturer shall be able to compete in the Continental market.

There appeared in a recent issue of your contemporary, *Engineering*, very full particulars regarding proposals for a great electrical development in Bavaria after the war. That the German Government should have the time at its disposal under existing conditions to develop so fully a scheme of the magnitude therein outlined is significant, and a fuller knowledge of these and similar intentions should do more than any amount of semi-political propaganda to foster and create commercial impetus and efficiency in this country, and arouse the British manufacturers and purchasers to a truer perspective of things, thereby enlarging their outlook and stimulating a broad-minded international industrial policy.

A. Nicholls Moore,
Borough Electrical Engineer.

Newport (Mon.), *January 22nd*, 1917.

[Mr. Moore's motto is evidently *Fiat justitia, ruat coelum!* —or, in more homely phrase, "Give the devil his due." We have no objection to this, and accordingly we commend Mr. Moore's candour in admitting that the breakdown was the result of negligence; as for the reference to the annual overhaul, it is clear from his remarks that this had nothing to do with the breakdown, and that the plant would have been out of commision for some weeks owing to the breakdown alone. Had our correspondent mentioned in his report the cause of the breakdown, we should not have included this item in our list; but he anticipates that its inclusion will be justified at a later date, for he foreshadows trouble with the turbine in the future.

Mr. Moore's detachment from mundane affairs is exemplified in the judicial impartiality with which he holds the scales between British and German manufactures, and his suggestion that the former are not faultless. No one said they were; but the Germans have specifically claimed that the workmanship and design of their products are such as to render breakdown impossible, and such claims can, and should, be refuted by specific instances of their falsity. The majority of the instances that we gave related not to "much-maligned municipal authorities," but to companies, and we have pleasure in publishing a supplementary list in this issue. It is not for us to compile a similar list of breakdowns of British plant, or to fight the Germans' battle for them in any other respect. We are acutely conscious that we are at war, and while we admire the chivalry of the French officer of old, who courteously invited our troops to fire first, we hold that consideration for the feelings of the barbarians who are ranged against us would be casting pearls before swine.

For the rest, we are content to leave our correspondent's remarks, and the leading article which he attacks, to the judgment of our readers. Any "broad-minded international industrial policy" which will assist the Teutonic policy of "peaceful penetration" in the future, to the detriment of British electrical industry, is quite outside the compass of our sympathies. Since writing his letter Mr. Moore has probably read the proposals of the supreme head of the German electrical industry regarding preparations for the next war, which appeared in our "War Items" last week.—EDS. ELEC. REV.]

Women and "Shorts."

I do not wish in any way to ridicule the assistance the fair sex are giving in all spheres of labour at the present crisis, but I certainly think there are many instances where female labour can *not* be resorted to with advantage and safety.

One naturally hears "things" through the general power and sub-station gossip, such as female switchboard sub-station and turbine attendants, the Marylebone Council being great on this, with the following result: quite recently they had a "short" in one of their subs., in which they employed female labour. I don't know if the attendants got the "blues" over it, but they had perforce to call in the aid of the ubiquitous "Bobby," which recalls to my mind two perhaps rather ancient and hoary, though at one time very popular songs; and I think one might very advantageously be entered in the general instructions for sub-station attendants by the above Council, thus:—

If you want to right a "short"
Ask a p'liceman.
Little Miss Lovebird, the other day,
Had a short-circuit down Marylebone way;
Her assistant and she almost had fits,
They thought the sub-station was going to bits,
So they went and fetched a policeman.

Exciter.

An Appeal for Calendars.

Would any of your advertisers care to send us a few calendars for 1917? These would be very acceptable, as they are not, as you are aware, an Army issue.

F. L. Cater, A.M.I.E.E.,
Second-Lieutenant, A.S.C.

373 M.T. Co., A.S.C., Newmarket.

Sapphires for Industrial Purposes.

Our Queensland Government's geologist, Mr. B. Dunstan, wrote in his mining report, January 22nd, 1916, thus: "Just as the crystallised diamond would be quite unfit for industrial purposes, *i.e.*, for draw-plates or certain pivots, and contra-pivots, the same with the crystallised sapphires; it is only the opaque sapphires that are tough enough to be used for industrial purposes." I was puzzled that, of later years, gem dealers and cutters of draw-plates, pivots, and contra-pivots in Europe boycotted these grades of sapphires to such an extent that the Queensland gem miners, who were dependent on their whole sapphire output, were driven to misery, and many of them had to leave the gem mines, the miners' situation getting worse, so that at the beginning of 1914 I had to make a trip to Europe for investigation. This was not an easy undertaking, because, through a clever combination, the whole gem trade in Europe is more or less shrouded in a mysterious darkness.

However, through an article written in a Parisian magazine, *La Science et la Vie*, of April, 1914, by Mr. Ch. Boulanger, Preparator at La Sorbonne and the Faculty of Sciences of Paris, I learned that many factories had been established here, where the scientific sapphires, rubies, and white sapphires were manufactured in such fabulous quantities that each fac-

tory could produce daily from 96 to 112 lb. of these artificial gem stones; it is only natural that the greater part of these chemically-made crystals turned out defective, and could not be cut into gems for jewellery, and the Continental lapidaries soon conceived the idea of cutting these artificial gems into draw-plates, pivots, and contra-pivots for sale to the wire-drawers and electricians, and our Government has been letting this go on for many years without taking any notice of Mr. B. Dunstan's statement. This encouraged some more manufacturers to make chemical imitation stones, having the composition of alumina 57 per cent., silica 33 per cent., and other mineral substances 10 per cent., as these were easier for cutting.

According to information obtained from some wire-drawers and electricians, this traffic forced most of them to go in more for the use of the expensive carbon-diamonds for draw-plates, because draw-plates of our hard opaque Australian sapphires were not often offered to them for sale, as in olden times.

It thus happened that a large electrical wire-drawing firm here asked me to supply them with four carats sized good carbon-diamonds for draw-plates; as I had none, I sent them samples of our hard opaque Australian four carats sized sapphires. They found out, after trying these, that they could replace the diamond draw-plates, and ordered from me for frs. 120 these sapphires; the same quantity of four carats sized good carbon-diamonds would have cost them about 83,125 francs. Afterwards I submitted samples of the same grades of sapphires to wire-drawers of brass, copper, iron, and steel wires, which gave equally satisfactory results. The worst thing is that only a few of the largest wire-drawing and electrical firms have cutters attached to their factories, and the others are dependent on the Continental manufacturers of draw-plates, pivots, and contra-pivots for their supplies. How would it be if in England, wire-drawers and electricians would attach to their factories lapidaries for the cutting of the said articles? In buying the rough, hard opaque sapphires themselves, they would not only realise handsome profits, but they would help also our Colonial gem miners to get a sale for these grades of genuine gem stones, and thereby better their critical position.

H. Bengtsson,

Delegate for the Queensland Gem Miners.

Paris, *January 21st*, 1917.

City and Guilds Examinations.

In their last two letters on the above subject, Messrs. A. P. Lundberg & Sons express regret that no teacher of the subject of "Electrical Installation Work" has had the *energy* to join in the correspondence, and conclude their letter in your issue of January 26th with the remark: "There are obvious reasons, of course, why men in that position should hesitate to state their views publicly."

Quite so; and one of the strongest reasons is that they are assisting their country in the production of urgent commodities, merely being *visiting* teachers at the polytechnics and other similar centres. There are few (if any) teachers of the above subject who are engaged fully, as it would not be possible for the students to attend except in the evening. Perhaps Messrs. A. P. Lundberg & Sons will oblige with a list of obvious reasons, and, while doing so, keep in mind that some men will never attempt to write a letter for publication even though, by so doing, they would serve a good cause.

In one of their letters on the same subject, a reference is made to students of the Grade II Classes being able to enter Grade I examinations and obtain certificates of the same class as when taking the examination in the previous year. The explanation is that, as it requires two years' training after passing through Grade I to prepare students successfully for the final examination, teachers and others concerned consider it beneficial to the students to enter the Grade I examination during the first year in the Grade II classes in order to keep them in touch with the earlier work.

As to whether the subject is grossly neglected or not, it would be beyond the average teacher's ability to define. They know how the subject is taught in the centres where they are engaged, and perhaps learn of the happenings in a few others, but not sufficiently to be able to generalise. Maybe Messrs. Lundberg & Sons, in addition to conducting switching competitions, which have a good educational value apart from being admirable from the advertising point of view, also engage in teaching "Electrical Installation Work"; if so, there may be many teachers who would welcome the following information:—

1. How many students they have coached successfully for the City and Guilds examinations during the last three years?
2. What were the total student-hours per session?
3. The percentage of students actually engaged in the subject as a trade?
4. Why the Final Grade is presumed to require two sessions' training after passing through Grade I?
5. Is it not a fact that when a student has attended two sessions of the "Wiring Classes" he joins the Intermediate "Electrical Engineering Classes," that is, if he is diligent, wishing to pass beyond the practical stage in order to obtain higher technical knowledge and skill?
6. Would it not tend to higher percentages of successes in the examinations if the students were actually engaged on "Electrical Installation Work" as a trade?

The writer always found the subject of "Electric Wireman's Work" (now named "Electrical Installation Work") well catered for in the polytechnics to which he has been attached, and has known a good proportion of students taking Grades I and II of Electrical Engineering to attend the practical wiring class in conjunction with their course.

No doubt the reason wiremen have been in the minority at classes will be found in the following list:—

1. Their work necessarily takes them into outlying districts, preventing them attending regularly.
2. Employers have never seriously encouraged technical training among their wiring staff.
3. Men of mature age object to displaying their lack of knowledge before juniors.

More could be added.

It was recently announced in your columns that the Electrical Contractors' Association had seriously tackled the subject of examinations of wiremen, and we may hope that, in addition to being permitted to nominate an examiner, the Association will inquire into the teaching methods employed, and see that there are no grounds for caustic comments from manufacturers.

No Energy.

The Sale of Foreign Motors.

We are continually receiving letters from old customers (no doubt in common with other firms) stating that they want machines under Class "C." They offer us their orders, and, as is well known, all electric motor manufacturers have had to give an undertaking not to supply Class "C" material owing to the copper and steel restrictions; yet the letters that we receive regularly contain a sentence such as follows:—"Unless you are in a position to supply us with the machines we shall have to obtain them elsewhere." We should like to know what firms are doing this dirty trade, and what precaution can be taken to prevent it. Also, are firms who import foreign motors allowed to sell them without a certificate and Ministry of Munitions permit number? If so, it is a gross unfairness, and giving our foreign competitors an unequal chance. We never object to foreign competition on a fair basis. If our factories cannot produce all the electric motors that are essential for war purposes, it is only right that they should be imported, but this concession should be rightly used, and not abused, and we trust some steps will be taken in the matter to prevent its continuation at an early date.

Higgs Bros.
W. F. Higgs.

Birmingham, *January 26th*, 1917.

BREAKDOWNS IN GERMAN PLANT.

In a paper recently read before the South African Institute of Electrical Engineers, Mr. A. E. Val Davies gave some interesting examples of breakdowns of German plant in connection with the South African power companies during the last four years. The author stated that his list could be greatly extended.

He explained that the generators, which represent an aggregate of 218,800 K.V.A., are all of the turbo-alternator type, their ratings varying from 3,500 to 18,000 K.V.A., and their speeds being either 1,000 or 1,500 R.P.M. The ratings of the transformers, which are all of the water-cooled type, vary from 4,000 to 12,500 K.V.A., the total being 388,500 K.V.A.

In seven generators, each of 12,000 K.V.A. and of identical design, the joints between the stator bars and the end bends were of most primitive design, and were, to start with, mechanically weak. Three hollow rivets were provided to hold the two forked ends of the bends to the bar, and the joint thus made was soldered with a soldering iron. When these joints were opened up a great majority of them were found to be devoid of solder inside, there being merely a beading of solder round the edges. The usual cause of failure was that the beading cracked away, leaving the joint held by the rivets only; it then heated up and gradually burnt away the surrounding metal till the joint ultimately failed by the melting off of the end of the bar and bend. On three occasions the following arcing burnt into the binding wire of the rotor, which thereupon slacked away and ripped the insulation from the remainder of the end windings. This defective joint was responsible for the loss of many thousands of pounds directly and indirectly.

The rotors of all the generators are fitted with wire binders round the ends of the rotor windings. Abutting the rotor poles a copper alloy wire, with an ultimate strength of 40 tons per sq. in., is used to prevent to a certain extent the magnetic leakage which would occur if steel wire were used, and special steel wire, with an ultimate strength of 128 tons per sq. in., is then laid on in the remaining space, both wires being laid on at a tension corresponding to 20 tons per sq. in. There can be no question as to the mechanical strength of these binders, and their construction eliminates the possi-

bilities of internal stresses and unrelieved strains to which a solid shrunk-on cap might be subject; but this hardly compensates for their unfortunate proclivity, once the outer turns are burnt through, of stripping into miles of wire, which forthwith is ground up in the air gap of the machine, ruining not only the windings, but often the core plates of the stator as well. This unfortunately occurred three times. In two 18,000-K.V.A. machines, of different speeds and design, the rotor binding wire was found to heat up to a temperature sufficient to melt the solder, which was flung off upon the end-windings of the stator.

A breakdown occurred in a 12,500-K.V.A. machine fitted with a dry air-filter, composed of a zig-zag arrangement of filter cloths in wooden frames, which was placed below the generator floor level. Owing to the failure of a current transformer installed 12 ft. away from the filter and on the generator side of it, severe arcing presumably set fire to the filter cloths, although, according to the specification, they were supposed to be fireproof, and the whole filter became ignited.

In one case a bank of four 6,000-K.V.A. transformers working on a ratio of 80,000 to 20,000 volts, failed within a few days of each other owing to the perforation of their respective water-cooling coils, which were of iron, and the consequent flooding of the windings. In the case of the first, a lump of zinc was found in the bore, and this caused a stream of water, which was decidedly acid, to impinge on the side of the tube, which was finally punctured by the continued erosion. In the other transformers obstructions were also found in the pipes, which in several cases all but blocked the bore. In a batch of six transformers there were failures in four, owing to perforation of their lead cooling coils, the breakdowns being due to faulty drawing or extrusion of the tubing. In some of the faulty coils the thickness of the metal varied from a few thousandths of an inch on one side to nearly ¼ in. on the other side, the proper thickness being ⅛ in.

A 12,500-K.V.A. core-type transformer was removed for examination after tripping, and when an attempt was made to lift off the upper yoke of the core it was found to be thoroughly welded to one of the vertical limbs. This breakdown was due to a succession of failures of the insulation round the core bolts in both the top and bottom yokes. The resultant flow of current melted into a solid mass almost a cubic foot of iron core plates in both the yokes, and presumably, after the pad of insulating material between the yoke and limb had been damaged, a further circulation of current took place across the joint thus made. The net result of this breakdown was the scrapping of the machine.—*The Times Engineering Supplement.*

WAR ITEMS.

Enemy Companies Winding Up.—A Supplement to the *Board of Trade Journal* of February 1st contains a complete list (to January 25th) of the names of firms which have been ordered by the Board of Trade to be wound up under the Trading with the Enemy Amendment Act, 1916. The date of the order is given in each case, together with the name and address of the Controller appointed, and an alphabetical index of the firms is included.

Discharged Men in Kinemas.—The Kinema Employment (and Sale) Bureau, of 18, Cecil Court, Charing Cross Road, W.C., which has been finding light employment in various capacities in kinemas for disabled and discharged soldiers and also employment for the wives of soldiers now serving at the Front, has several vacancies on its books. A free register of discharged and disabled men is kept.

Labour After the War.—Mr. J. Hodge, the Minister of Labour, is reported to have stated, in a recent speech at Manchester, that he was about to form a big central committee, and four or five hundred local committees in different parts of the country, to consider the vast problem of after-the-war employment. He referred to the great need for hearty co-operation between employers and employed in connection with this and other problems of labour and industry.

Controlled Works.—The total number of controlled establishments is now 4,719.

Exemption Applications.—At the Plymouth Tribunal, two apprentices to electrical engineering, who had each paid a £50 premium, applied for exemption. The Military opposed the application on the ground that the lads were 18 and passed for general service. The Mayor remarked that it was hard that any advantage of the premiums paid should be forfeited, but in view of the new circular the Tribunal felt they could give no exemption.—*Western Morning News.*

At Southwark, Coun. T. E. Hewitt, a member of the Tribunal, carrying on business as an electrical engineer at Newington Causeway, applied for the exemption of three employés, all passed for general service. These were a sheet metal worker, 28, single; a tinsmith, 26, single; and a second tinsmith, 23, married. He stated that these were the only three men left working at the bench. Under existing conditions he could not expect lengthy exemptions for them, but he asked that he might keep them until he had completed a Government contract. The men had been in certified occupations until recently, but were now taken out of the list. Before the war he had 17 bench hands and five fitters, but now only had left these three bench hands, one fitter, and a foreman, and if these men went he would have only the foreman and fitter left. He had a row of empty benches with no men to do the work. His present contract would take just over a month to complete, but he was doing the hardest part of the bench work himself. Three months' exemption was granted in each case.

At Southport, the borough electrical engineer applied for four men, who, he said, were formerly badged. The Minister of Munitions had informed him that if they were called up he must send a certificate to the Recruiting Officer that they could not be called up until substitutes were found. The cases were adjourned for inquiries.

At Rochdale, Mr. G. Webster, in appealing for J. Crossley (36, single), overhead electric wireman; J. W. Milnes (35, single) and J. Hird (37, married), the two last-named motormen, said he had only two skilled wiremen to look after 40 miles of overhead equipment, and on some of the older sections the calls for the wiremen were more than double what they were two years ago. It would take a stranger a considerable time to get into the method of the Rochdale feeder system, and unskilled men were out of the question. As to the drivers, he had to study the safety of the public, especially considering the dark nights. All three men had been passed for general service. Milnes was put back to March 31st, and the others to April 30th.

At Deal, exemption was claimed for Mr. C. H. J. Graves (29), electrical engineer of the "South Eastern" Hotel, originally rejected, and now passed for general service. It was stated that Mr. Graves could not be replaced, and that if he had to go there would be no alternative but to close the hotel, as it would be impossible to keep open without a supply of electricity. The Advisory Committee said that Mr. Graves should be released for military service, even if the hotel had to be lighted by lamps. The Tribunal allowed two months, with no further application without leave.

At Dover, on January 24th, the Military Representative asked for the withdrawal of conditional exemption granted by the Recruiting Officer to six tramway drivers in the employ of the Corporation. One, it was stated, had given notice to leave, and was going to work for the Admiralty, and the Tribunal decided to grant no exemption to him, leaving the case to be fought out between the Army and Naval authorities. As to the rest, it was urged that the men were in a certified occupation. Mr. Robson said that he looked on tramways as a luxury, but Mr. Carden pointed out that they were recognised by the Government as a public utility service. One was given conditional exemption until a substitute is found, and the certificates of the others were withdrawn.

At Leyton, on January 22nd, Mr. A. Partington, clerk to the Ilford U.D.C., applied for exemption for eight tramway employés. Captain Howard said that the tramways had done all they could to meet the situation, and it was highly creditable to them. The appeals were respited for three months.

The Southend-on-Sea Tribunal, on January 22nd, refused an appeal for the exemption of A. V. Harrison (31), electrician at the Hippodrome, claimed as being indispensable. The calling-up was deferred until April 1st.

At Oxted, on January 24th, Major Chas. Leveson-Gower, J.P., of Titsey Place, Limpsfield, appealed for H. Maynard (36), in charge of the electric water-raising plant, &c., on the estate. It was stated that the installation of the plant cost £3,500, and that Maynard could not be replaced. Conditional exemption was conceded.

At Epsom, an electrical engineer and contractor, aged 36, applying for exemption, said that he was the head of businesses at Epsom and Sutton, and if he had to join up he would have to close down both businesses, it being quite impossible to find a manager to do the mechanical work. Two months were allowed.

At Weymouth, the Town Clerk applied for exemption for the electrical engineer, Mr. J. H. Bolam, whose certificate granted by the Recruiting Officer had been withdrawn. The application was acceded to.

The West Kent Appeal Court has granted two months' exemption, with no further appeal without leave, to A. Stubberfield (27), of Beckenham, foreman in an electric battery factory, passed in Class B1.

At Watford, Mr. Barham, electrical engineer to the U.D.C., applied for exemption for H. Tomkins and L. Cook, engaged at the electric light station. He said that both men had been de-badged, and as he was waiting for certain information from the Ministry of Munitions, he applied for the cases to be adjourned. The Military Representative replied that both were young men, one being 26 and the other 30, and an adjournment was only putting off the matter again. He asked if men could not be found to take their places. Mr. Barham replied that they had tried to replace them, but had failed. The Tribunal decided to adjourn the cases as requested.

The West Kent Appeal Court has again had under consideration the case of Mr. A. Leach, electrical engineer, of Maidstone, previously referred to in the ELECTRICAL REVIEW. Mr. Leach claims having applied for naturalisation in the United States, and he desires to return there; his earlier return has been prevented by his wife's illness, and was borne out by a letter from him to the Home Office in April,

1911. The Court granted three months' exemption conditional upon his receiving permission, and leaving for the United States within that period.

The Woodbridge (Suffolk) and District Electric Light Co. applied to the local Tribunal for exemption for their engineer, aged 27, who has charge of two power stations, on the ground that he is in a reserved occupation. It was mentioned that the company had been invited to supply current to another centre in the district. Three months were allowed, with leave to appeal again.

At Teddington, an appeal was made by the London United Tramway Co. for two tram conductors, a motorman, and a driver, whose certificates of exemption have been withdrawn on the ground that it is no longer necessary that they should remain in civil employment. It transpired that, under instructions from the War Office, the company's 1,500 men had been inspected by the Recruiting Officer at Chiswick, and all men in any fit category for military service had been taken, leaving about 200 motor drivers and a few highly-skilled men, such as electrical experts, &c. Major Smith, of Chiswick, in a letter, expressed the opinion that the few exceptions granted should be respected, and that the four claims should be transferred to the Chiswick Tribunal. The Clerk mentioned that the four men had been exempted by the War Office, and the matter was adjourned for an explanation from the Military authorities.

BUSINESS NOTES.

Book Notices.—"Willing's Press Guide" has now reached its forty-fourth annual issue. It contains a mass of useful information regarding the Press of the world. We have always found it a very handy and reliable work of reference. The printers' errors noticeable here and there are, doubtless, consequent upon the increasing difficulties of war-time.

"Registration of Business Names." By H. W. Jordan. London: Jordan & Sons, Ltd. 6d. net.—This booklet sets out the requirements of the new Act, and quotes examples.

"Alternating Currents." By C. E. Magnusson. London: Hill Publishing Co. Price 17s. net.

The Report of the War Refugees' Committee (General Buildings, Aldwych, W.C.) contains a full account of the Committee's work, with a balance-sheet, and illustrations showing scenes outside the offices after the fall of Antwerp, and Belgian soldiers on leave at Christmas, 1915.

The British Dominions General Insurance Co., Ltd., has published its very acceptable "British Dominions Year-Book for 1917." Amongst the articles, first and foremost is one by the Earl of Cromer (whose death we lament as we write) on "The Aftermath of the War," and there are others on "Labour, Commerce, and the Empire," by Edward Salmon; on "Trade Opportunities in Latin America," by Percy F. Martin; on "The War's Three Phases," "India's Future in the Empire," "Trade Before and During the War," "The Civil Engineer and the Future," by Lord Headley, "War Finance and the Future," "National Insurance," and a whole host of other contributions, accompanied by maps, coloured plates, and other illustrations.

"L'Annuaire du Bureau des Longitudes pour 1917." Paris: Gauthier-Villars et Cie. Price 2 fr.

"The Practical Electrician's Pocket Book and Diary" for 1917 (London: S. Rentell & Co., Ltd. Price 1s. 6d. net) is almost out of its 'teens, and needs no commendation; it has been revised by the Editor, Mr. H. T. Crewe, and a chapter has been added dealing with electric furnaces. There are few branches of electrical engineering upon which it does not touch.

"Local War Museums: a Suggestion." By C. Reginald Grundy (Editor of "The Connoisseur"). 3d.

Catalogues and Lists.—The Hillbar Press, 72, Finsbury Pavement, London, E.C.—Folder relating to their supplies for the dry battery trade.

Messrs. David Brown & Sons (Huddersfield), Ltd., Park Works, Lockwood, Huddersfield.—Twelve-page illustrated pamphlet containing particulars of their D.B.S. carburiser for case-hardening.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet V 2,087, giving prices and particulars of small power electric motors.

Messrs. Grindlay, Ross & Co., Ltd., of 47, Waterloo Street, Glasgow, have issued loose blotters, showing the situation of their premises in the city.

The Langdon-Davies Electric Motor Co., of 110, Cannon Street, E.C., have also circulated loose desk blotter slips.

British Electric Plant Co., Ltd., Alloa.—Four-page leaflet, giving illustrations of their works and of electrically-driven haulage gears.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Twelve-page illustrated price-list of "Plexsim" electric heating and cooking apparatus for industrial and other use.

Catalogues Wanted for Russia.—Owing to the special importance, at the present time, of establishing commercial connections on a firm basis between the Allied countries, with the object of ousting German intervention and competition, the Russo-British Chamber of Commerce at Petrograd asks us to request all British firms wishing to trade with Russia, now or after the war, to send their catalogues and price lists (not less than 10 copies) to the Chamber at 4, Gorochovaia, Petrograd, Russia. The catalogues will be placed in the special library of the Chamber, and will be distributed to Russian merchants interested in the development of their trade connections with England.

Bankruptcy Proceedings.—G. E. Bonner, electrical agent, 105, Fox Lane, Palmer's Green. Trustee released Jan. 19th.

H. H. Oxley (otherwise Oliver Huxley), consulting engineer, Hanwell.—February 10th is the last date for the receipt of proofs for dividend by Mr. E. W. J. Savill, Official Receiver, 14, Bedford Row, W.C.

C. J. Ogilvie, electrical engineer, 43, Dudley Road, Whalley Range.—The first meeting of creditors herein was fixed to take place on January 24th at the Official Receiver's offices, Byron Street, Manchester, but there was not a quorum of creditors present, and the matter was, therefore, left with the Official Receiver who will act as trustee.

Calendars.—Mr. Albert E. Mallandain, of 51, Cheapside, E.C., has issued a calendar for 1917, with monthly slips, on each of which is also given a complete calendar for the year.

Messrs. Taylor & Challen, Ltd., of Derwent Works, Birmingham, have sent us a wall calendar for 1917, with monthly slips; on the reverse side of each slip, which turns down when done with, there is a half-tone view of metal presses, &c., supplied by them.

Dissolutions and Liquidations.—Attwater & Sons engine packing manufacturers, &c., Hopwood Street Mill, Preston, and the British Rubber Co., 28, Friargate, Preston.—Messrs. R., F., C., and C. Attwater have dissolved partnership, so far as Charles Attwater is concerned. Debts will be attended to by the remaining partners, who will continue the businesses.

Radium, Ltd., 93, Mortimer Street, London, W., dealers in radium and radio-active substances, &c. (enemy subjects). Creditors must send particulars of debts, &c., to the controller, Mr. C. R. Beeby, 66, Basinghall Street, E.C., by February 24th.

R.E.T. Construction Co., Ltd.—This company is winding up voluntarily, with Mr. A. Page, 28, King Street, E.C., as liquidator.

Krupka & Jacoby, Ltd.—The Controller, Mr. Thomas Wise, has applied for his release.

Durban Municipality and Preference.—The Durban Town Council has taken action with the object of encouraging British trade. The Finance Committee has authorised the general storekeeper to give a preference up to 10 per cent. to goods produced and manufactured in the United Kingdom, as against American goods. Further, in accordance with a previous resolution of the Council, to the effect that Natal Municipal Councils and Local Boards should make a return of those goods which in the past they have been accustomed to purchase from foreign countries, with a view to publication for the benefit of British manufacturers, the Council has forwarded such a return to the Natal Municipal Association. Amongst the goods included in the return are the following:—

Tramway Supplies.—Electrical equipment and spares, trucks, fenders and spares, trolley wheels and bushes, trolley cord, and tramcar seats.

Desk and wall telephones, bitumen, grease compound, metallic-filament, &c., lamps, oil (engine, cylinder and dynamo), transformers (single-phase).

In some instances the return gives the names of the foreign makers from whom some of the above-mentioned goods have hitherto been obtained, and in others details as to sizes and weights are given. Such further information as is available may be obtained by United Kingdom manufacturers and exporters of U.K. goods, on application to the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Agencies Wanted.—A Johannesburg agent seeks the agency for a British manufacturer of three-phase electric motors. Reference 37/92.

A manufacturer's agent desires agencies for British makers of scientific instruments, meters, telegraph and telephone instruments. Reference 30.

Particulars from Department of Commercial Intelligence, 73, Basinghall Street, E.C.

Registration of Business Names.—Under the new Act, an office has been opened at 39, Russell Square, London, W.C., for the registration of firms and persons whose principal places of business are situated in England and Wales. Separate offices will be opened in Edinburgh and Dublin for Scotland and Ireland. The earliest date on which it is permissible for particulars to be furnished, with a view to registration, is February 22nd. The particulars must be furnished on Board of Trade forms, obtainable at post offices later.

Trade Announcements.—Mr. Philip Herd, of Johannesburg, has entered into partnership with Messrs. Peabody, Rice, and Wilson, and the title of the new firm will be Rice, Wilson & Herd. Mr. Herd has been associated with the South African interests of the B.T.H. Co., Ltd., of Rugby, and the General Electric Co., of Schenectady, for many years. The address of the offices will be unchanged—86-88, Strand Bank Chambers, Commissioner Street, Johannesburg.

The Ainsdale branch of Messrs. T. Wainwright & Sons, Ltd., electricians, Southport, has been closed for the duration of the war, Mr. T. Wainwright, jun., being called up.

The address of Le Carbone has just been changed to Coventry House, South Place, E.C. New telegraphic address: "Lacombe, Ave, London."

LIGHTING AND POWER NOTES.

Australia.—The Victorian Hydro-Electric Co., Ltd., has been granted a licence for a term of two years, at a rental of £25 for the first year and £50 for the second, for the diversion of water from the Kiewa river for a proposed power installation.

The Perth (W.A.) City Council has re-allocated the sum of £20,000, set aside for the erection of a gas retort house, for the purchase of gas and electric plant and extensions.

Canada.—According to the *Canadian Engineer*, the Russian Government has requested detailed information regarding the facilities available in Canada which might be used in Russia for carrying out extensive hydro-electric power schemes now under consideration in that country. The Dominion Water Power Branch has been asked to supply information regarding Canadian experience in hydro-development, also electrical and mechanical manufactures for such projects, and other bodies have been asked to assist in various ways.

The following, taken from the *Canadian Engineer*, shows the amount of electrical energy produced for export and home use by certain Canadian companies :—

	Units for export. KW.-hours (thousands).	Units for use in Canada. KW.-hours (thousands).	Total output. KW.-hours (thousands).	H.P. Years.
Can. Niagara Power Co.	400,521	11,178	411.700	62,999
Electrical Develop. Co.	34,652	395,346	429,998	65,799
Ontario Power Co. ...	199,135	616,834	815,969	124,862
Ontario & Minn. P. Co.	13,144	11,789	24,933	3,815
Cedars Rapids P. Co. ...	358,753	56,031	414,784	63,471
Sherbrook R. & P. Co....	230	8,605	8,836	1,352
Maine & N. Bruns. P. Co.	3,075	242	3,318	507
West. Canada P. Co. ...	11,937	60,468	72,405	11,079
Brit. Col. Elec. R. Co....	330	68,470	68,801	10,528
Totals	1,021,780	1,228,966	2,250,747	344,416

Chile.—Concessions have been granted to Senor Navarro to develop electric power from the Agua Fria, and to Hermanos and Co. to utilise the water of the River Leira for generating electricity for industrial purposes.

Continental.—Russia.—The Baku electrical company called the Elektricheskaya Sila has had to circularise its new subscribers, expressing regret that it cannot connect them for want of material.

The Tiflis Council has obtained permission to issue a loan of 210,000 roubles to extend the central electrical station.

The Irkutsk Council is also authorised to borrow 228,878 roubles, in order to supplement the equipment of and to extend the electricity station, against a deposit with the local bankers of 4 per cent. Government Rentes, equal to 350,000 roubles nominal.

The total cost of extending the electric lighting system and repairing boilers at Vladivostock is estimated at 105,000 roubles, which it is proposed to pay off by increasing the price of current; but permission to go on with the work is being delayed until a 250,000 roubles loan from the local branch of the Siberian Trading Bank has been realised.

Dublin.—Asylum Lighting.—At a meeting of the Joint Committee of Management of the Richmond Lunatic Asylum, the chairman said the electric lighting of the asylum buildings had effected a remarkable saving, the cost being a little over one-third that formerly incurred by gas lighting.

Dundalk.—L.G.B. Inquiry.—Mr. P. C. Cowan recently held an inquiry into the application of the U.D.C for sanction to a loan of £5,000 for the electricity undertaking, some £2,000 of which was desired to repay certain interest and sinking fund charges, being the first instalment in connection with a loan of £21,000 for plant to supply the works of the G.N. Railway of Ireland, which, due to the non-delivery of engines, was not productive for 15 months later than it would have been in the ordinary way. It was urged that the plant was non-productive through no fault of the Council, and it would be unfair to impose the liability on the rates. It was argued that although there was no precedent for such an application in the case of a public body, there was no reason in law why it should not be acceded to. Mr. Cowan said the right to charge interest to capital, when admitted, was usually provided for in local Acts; failing that, there was the alternative of putting the deficit on the rates. To hold the balance of the loan, or part of it, as working capital was also a novel point. He advised that £500 should be put on the rates, as he thought they had no right to carry forward adverse balances. It was pointed out that as the undertaking had no working capital, it had to work on the revenue of the preceding half-year, and so was a year behind in repaying to the Council interest and sinking fund moneys; although this was of small account when capital charges were small, the Council could not afford to do it when the charges were £3,000 a year. The inspector did not see how the Council could get relief in the manner proposed, but agreed to report fully; he also complimented the Council and its engineer (Mr. Spalding) on the power station.

East Ham.—It has been resolved that for the present that no alteration be made in the charges for current.

Epsom.—The U.D.C. has decided to ask the B. of T. to withhold consent to the application of the South Metropolitan Electric Tramways and Lighting Co. for a prov. order for Ewell, as the Council, which already supplies a portion of the parish, is quite capable and willing to extend the supply when the proper time arrives.

Hornsey.—A serious defect recently occurred in the crankshaft of one of the engines at the Council's generating station. The repairs are to be carried out at a cost of about £300. Gales carried away part of a cooling tower. The damage is to be made good at a cost of about £57.

Hull.—Estimates.—The acting electrical engineer, Mr. J. F. Magoris, in his estimates for the financial year ending March 31st, 1918, reckons on a total revenue of £105,714 (£101,104 from sales of electricity), and expenditure amounting to £102,706 (fuel £32,400, salaries £12,600, interest and sinking fund £37,946, rent, rates, &c., £6,710, engines and boilers £5,400, repairs, renewals of mains, &c., £1,400), leaving a balance of £3,008. The estimates were adopted, and referred to the Finance Committee.

Keighley.—Proposed Loan.—The Electricity Committee recommends the T.C. to apply to the L.G.B. for power to borrow £2,000 for laying extra-high-tension cable.

The War Bonus Committee recommends the granting of a war bonus of 2s. per week to officials over 21 years of age whose salaries do not exceed £200, and of half that amount to those under 21 years of age.

London.—Shoreditch.—New Plant.—The B.C. proposes to borrow a sum of £41,000 in connection with a scheme for extending the works and generating plant at Whiston Street. The Council had previously approved of estimates amounting £122,951, of which the L.C.C. has sanctioned £23,045, including the expenditure on converting plant and mains, &c., necessary for taking a bulk supply from the Stepney B.C. The remainder of the estimate (£99,906) was deferred by the L.C.C., owing to the proposal to provide a bulk supply for London.

In view of the increasing demand on the Shoreditch plant, and the loss of the bulk supply from Stepney, the borough electrical engineer has submitted a scheme for the installation of a large turbo-generator set in place of a reciprocating set, which is estimated to cost £41,000, including generating and converting plant, switchgear, cables, &c. The increased efficiency of the new plant will, it is estimated on the basis of the present year's figures, result in an increased profit, after allowing for loan charges, of £3,000 per annum.—*Hackney Gazette.*

Lambeth.—The General Purposes Committee has considered the question of its option in March, 1918, of repurchasing the undertaking of the South London Electric Supply Corporation, Ltd. The Committee has decided that the present moment is an inopportune one for repurchasing the undertaking, and accordingly notice to exercise the option will not be given. The Council has also the option of repurchasing the undertaking on March 16th, 1928.

Islington.—The electrical engineer reports that it is necessary to at once provide an additional feeder. The estimated cost of the work is £4,000, and the Lighting Committee is to proceed with the work forthwith as a matter of urgency.

Stepney.—The accounts of the B.C.'s electricity undertaking for the year ending March last disclose a deficit of £5,864, the first in 15 years. This was due entirely to the abnormal conditions, which Mr. Tapper in a summary estimated to have resulted in some £24,700 extra cost, coal, due to increased price, costing £9,350 more, and due to inferior quality £4,500 more. The ash content increased from 14 per cent. to 26 per cent. of the fuel consumed. The total units generated amounted to 27,800,000, and units purchased in bulk to 2,560,000, making a total of 30,380,000, an increase of over 7,000,000 on the previous year. Practically 25,000,000 units were sold; 4,500,000 for lighting, 9,700,000 for power and heating, 4,500,000 to private consumers in bulk, and over 6,000,000 units for public bulk supply. The total compares with 18¾ millions units in 1914-15.

The generating plant capacity was 17,720 KW., and the maximum load 9,874 KW.; the works cost, at ·558d. per unit, compared with ·46d. in the previous year, and the all-in cost was just over 1d. per unit sold. To meet the deficit and other expenses, amounting to a total of £13,760, £12,626 was transferred from reserve, the balance, £1,133, being in hand from the previous year.

The capital in the undertaking at March last amounted to £662,000, of which, roughly, £120,000 had been repaid, and £22,000 provided out of revenue, &c. This was apportioned as follows :—Limehouse station, £240,000; Whitechapel station, £129,000; Wapping sub-station, £13,000; instruments, tools, &c., £15,600; mains, £193,600; services and meters, £53,500; balance in hand, £17,000.

Stalybridge.—Increased Prices.—The Joint Board has decided to increase the charges for current for heating, domestic and power purposes, as from April 1st next, in order to meet the increased cost of coal, &c.

Tasmania.—A conference was held recently between representatives of the Launceston City Council and the Premier of Tasmania relative to the Council's participation in the Government hydro-electric scheme. Negotiations in respect to the matter began in August, 1915, and the Government offer was rejected. The Council proposed to sell out its undertaking and to erect its own transmission line from the Government power station, and, at the same time, it sought the right to supply all power in the north of the island. Special terms were laid down for the supply of power. The Premier stated that the question to be determined was whether, under existing conditions, the Council would be justified in scrapping £70,000 worth of plant now used in the electricity undertaking, and expending £71,000 to supply the power, or

whether it would not be sounder business to continue to meet the local requirements with the existing plant until conditions became nearer normal. He told the conference that the contracts of the Great Lake scheme would practically absorb the whole of the power available. Investigations showed that 45,000 H.P. could be developed from the Arthur's Lakes, and this would be reserved for the development of industry in the northern part of the State. He assured the Council that the Government would endeavour to obtain a customer for a fairly large block of power to locate works at Launceston.

At a meeting of the Launceston City Council, the report of the conference was discussed, and the Council has decided to take up the whole matter of increased power for the electric lighting and tramways undertaking at an early date.

Tyldesley.—The U.D.C. has decided to complain to the Lancs. Electric Power Co. regarding the inconvenience caused by failure of electric supply in the district.

Tynemouth.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st, 1916, show that 4,528,958 units were sold, as compared with 4,809,841 in the previous year, three-phase supply accounting for 2,671,652 and 2,844,860 units respectively in the two years. The total revenue amounted to £21,652, and after meeting all charges, there was a deficit of £513, as against a profit of £738 in the previous year. The deficit of £513 was met from funds in hand, and a surplus balance of £1,311 still remains.

Walthamstow.—Loan Sanction, &c.—The electrical engineer reports that it would not be possible to erect the steel chimney provided for in the original scheme for the new plant extension, and tenders are to be invited for the construction of a brick chimney. Plans are to be prepared for an extension of the sub-station and the boiler-house buildings. The L.G.B. has sanctioned the borrowing of £18,790 in connection with the extensions at the generating station.

TRAMWAY and RAILWAY NOTES.

Accrington.—The local branch of the Tramways and Vehicle Workers' Union is taking steps with a view to securing a war bonus for women conductors.

Australia.—The Tramways Board has issued a writ against the Melbourne Tramways and Omnibus Co., Ltd., claiming £250,000 for breaches of the covenants of the lease, which required that the lines should be handed over in good working order and condition; this, it is contended, has not been done.

Blackburn.—Fare Increase.—The Tramways Committee is recommending a revision of fares, which will affect every section except one; several overlapping stages are to be abolished, and the issue of return tickets discontinued.

Birmingham.—Subway Proposal.—At the last meeting of the Tramways Committee, the question of better tramway terminal facilities was under consideration, from the point of view of surface and underground methods. Finally, the general manager, Mr. A. Baker, was instructed to prepare a definite scheme for subways in the centre of the city.

The provision of trailer cars on certain of the tramway routes of the city has been before the Committee for some months; the difficulties have been gradually overcome, and it is hoped shortly to make arrangements for entirely equipping one route with tractors and trailers, and should this experiment prove satisfactory, the Committee will consider the desirability of reporting to the Council in favour of their introduction.—*Birmingham Daily Post.*

It has been announced that, due to the dislocated service, no contribution to rate relief will be made.

Brighton.—The Corporation is offering to supply the Sheffield Corporation with 75 tons of tramway rails, free on rail at Brighton, at £16 per ton. The Corporation has in stock 109 tons of new rails, in addition to a few old ones which can be used again, and will not require to use them all itself.

Continental.—Italy.—The Piedmont Savings Banks have decided to form a trust to provide the capital needed by the Italian Government for the electrification of the Bussoleno-Turin-Roneo Railway.

Dundee.—A meeting of the Scottish tramway managers was held in Dundee last week; the visitors were welcomed to the city by ex-Bailie Johnston, convener of the Tramway Committee. It was mentioned that in several cases ½d. fares had been abolished, and in one case the revenue had increased by between £4,000 and £5,000 in eight months, while the number of passengers carried had largely decreased; in every case the receipts had gone up. The question of insurance risks, owing to the large amount of unskilled labour employed, was discussed, as well as questions affecting the upkeep of permanent way and plant. The visitors were entertained to luncheon by the Corporation.

Ecuador.—The municipality of Quito is to grant one or more contracts for the construction of electric tramways from that city to any town or towns in the canton. The concessionaire will be granted exemption from the payment of all fiscal and municipal taxes, but will be obliged to hand over to the municipality at least 5 per cent. of the gross receipts from the undertaking during the first five years of operation, and thereafter the percentage is to be increased by 2 per cent. for each five-year period. The concession will be for a maximum period of 30 years, at the expiration of which the lines, together with all fixed and rolling stock, will become the property of the municipality. Work must be commenced within a period of two years from the signing of the contract. The municipality will make application for the duty-free admission of such materials required in connection with the projected system as must necessarily be imported from abroad.—*Board of Trade Journal.*

Glasgow.—Debt-free Tramways.—It was recently announced that the City tramway system was now free of debt, all the capital expenditure of £3,835,156 having been repaid or provided for.

Halifax.—Proposed Fare Increase.—Fares are to be advanced to the extent of about 50 per cent., workmen's fares remaining at the present rates, but not to be available after 4 p.m., and children's fares to remain unaltered. Transfer tickets it is proposed to advance 50 per cent. The Sub-Committee also proposes a curtailment of the service, the change involving a 30 minutes' service between 9 a.m. and 12 noon. These changes, if adopted by the full Tramways Committee and the Corporation, will probably come into effect on February 2nd.

India.—Electric Vehicles.—Mr. Milne, of the Simla Municipal Electricity Department, has issued a suggested specification for electrically-propelled cars for use in Simla, which was published in a recent issue of *Indian Engineering*. The main features to be embodied are:—

1. Compactness and light weight; mileage per charge being a secondary consideration.
2. Capability of ascending and descending grades of 16 per cent. and short emergency grades of 25 per cent.
3. Capability of turning very sharp corners.
4. Maximum speeds in both forward and reverse directions, to overcome grades.
5. Exceedingly powerful brakes.

Owing to the long grades, it is suggested that regenerative control might be employed, also that the steep grades may necessitate a special battery suspension to avoid spilling electrolyte.

Lancaster.—The electrical 'buses are proving a success: the electric tramways carried 140,458 passengers in December, being 50,884 more than in the previous December, the receipts, exclusive of season tickets, being £485, or £151 in advance of 1915.

Leeds.—Traffic Figures.—Still further increases are reported in the takings on the Corporation tramways, largely due to the decreased local train service and the increase in the railway fares. There was an increase last week of £208 as compared with the same week of last year, and the total takings for the 43 weeks of the financial year, so far, were £414,611, or £35,361 more than for the same period in the previous year. The number of passengers carried during the same period was 2,064,000, which is an increase of 59,000.

Leyton.—Electric Vehicle.—The District Council is purchasing a 2-ton electrically-propelled Edison motor vehicle for the collection and removal of house refuse.

Middlesbrough.—Tramway Purchase Proposal.—It was reported to a meeting of the G.P. Committee, last week, that a meeting had taken place of the Sub-Committee and representatives of the adjoining authorities concerning the proposed purchase of the tramway system belonging to the Imperial Tramways Co. (Middlesbrough, Stockton, and Thornaby), but delay had been occasioned because the other representatives had no instructions from their Councils. It was stated that unless the Corporations took over the system the company would, no doubt, get another seven years' lease.

Preston.—War Bonus.—At the T.C. meeting, last week, it was stated that the recent war bonus award to tramway workers would mean an extra expenditure of £1,200 a year.

Salford.—The manager of the Corporation Tramways has received the award of the arbitrators on the recent dispute, which led to a strike on the question of women inspectors. The Committee of Production has found that under the conditions arranged by the Corporation, and as a temporary and supplementary war measure, the objection raised by the men's Union to the employment of female inspectors has not been established.

The Tramways Committee has decided to revise the scale of fares at present in operation, and to revert to the charges of three years ago. At that time the concessions were estimated as being equal to a gift of over £2,000 per year to the travelling public. The alteration will mean an increase of a halfpenny on practically every stage. The shortage of labour and the increased use being made of the tramways, especially in the suburban districts, following upon the advance of railway fares, has led to this decision.

South Africa.—Railway Electrification.—With further reference to our note in the Electrical Review of January 5th, the *S.A. Mining Journal* says the more immediate question is the electrification of short sections such as the Wynberg line, the Sea Point Railway, the Springs-Randfontein line on the Rand, and some of the short-distance railways in the neighbourhood of Durban and Maritzberg. The *Cape Times* says that probably the Simonstown line would have been electrified many years ago had it not been for the technical controversy which had arisen between the merits of the single-phase and direct-current systems, the essential point at issue being the relative costs. In South Africa

the more general question upon which expert decision will be required is as to the relative cost of the present system of steam locomotives and that of electric traction. On the Simonstown and Sea Point lines the conditions would appear to be specially favourable for electric traction. All coal used on those sections has to be hauled from the collieries in the North or from Natal, fuel for locomotive use being thus at its costliest point in the Cape Peninsula. The traffic conditions on the same sections correspond more closely than in any other part of South Africa to the conditions ruling around London, where some of the suburban lines have long been successfully electrified. Another point in connection with the suggested electrification would be whether the Railway Department would generate its own electricity or would purchase it from the power companies and local authorities.

TELEGRAPH and TELEPHONE NOTES.

A Relay-Sounder.—The Railways Labour-Saving Device Co., of Davenport, Iowa, has devised a diaphragm attachment to a relay contact point which augments the sound of the moving armature lever to such a degree that a sounder is unnecessary. The instrument is popular in railroad offices and in other places where trouble with local batteries is experienced, and does its work well. Where a telegraph sounder is used, this instrument will well take its place.—*T. and T. Age.*

Australia.—At a recent meeting of the Royal Society Prof. Cooke stated that the Sydney Observatory had been fortunate in obtaining a recent form of Audion detector, with which no difficulty had been experienced in hearing conversations from Darien, Japan, Honolulu, and San Francisco, and even Tuckerton (New Jersey), 10,000 miles away, had been heard talking to Berlin.

Telegraphic and Telephonic Progress in 1916.—Reviewing the events of the past year, the *Journal Télégraphique* states that the following channels of trans-Atlantic communication by wireless telegraphy are now in operation :—Sayville, N.Y.—Nauen, Prussia; Tuckerton, N.Y.—Eilvese, Prussia; Chatham, Mass.—Stavanger, Norway; Marion, Mass.—Naerbo, Norway; Belmar, N.Y.—Carnarvon, Great Britain; New Brunswick, N.Y.—Towyn, Great Britain; Glace Bay, N.S.—Letterfrack, Great Britain; Louisberg, N.S.—Clifden, Great Britain. Trans-Pacific communication between San Francisco and Funabashi by way of a relay station at Honolulu is regarded as realised. Telephonic communication has been opened between Berlin and Sofia, and (by way of the United States) between Montreal and Vancouver, a distance of 6,800 km.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" to-day.

Melbourne.—February 14th. City Council. 699,000 arc lamp carbons. See "Official Notices" to-day.

March 21st. Victorian Railways. Half-watt lamps and lanterns. —*Australian Mining Standard.*

Banbridge.—February 3rd. Urban Council. Public lighting of the district with gas or electricity.

Bedford.—Electricity Department. Extensions, comprising buildings, boiler-house plant, turbo-generator, steam and water auxiliaries, switchgear, &c. See "Official Notices" January 19th.

Cheltenham.—February 14th. Corporation. Twelve months' supply of electric light fittings. Mr. J. S. Pickering, Borough Engineer.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramway Engineer.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" to-day.

Keighley.—February 24th. Keighley and Bingley Joint Hospital Board. Electricians' work for 12 months in connection with the Morton Banks Sanatorium and Keighley War Hospital. Tenders to Mr. J. N. Clarkson, Clerk to the Joint Board and War Hospital, 40, North Street, Keighley.

London.—Battersea.—February 6th. Electricity Department. Oils, engine-room stores, meters, joint-boxes, &c. See "Official Notices" January 19th.

Bermondsey.—February 22nd. B. of G. Three, six and twelve months' supply of electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

Hammersmith.—The Electricity Committee has recommended the B.C. to invite tenders for annual contracts for electric light sundries, insulated wires, packing and jointing materials, joint-boxes, connections, &c.

Manchester.—February 2nd. Electricity Committee. Cooling towers. See "Official Notices" January 19th.

February 13th. Corporation Tramways Committee. Stores. See "Official Notices" January 26th.

Pembroke (Ireland).—February 5th. U.D.C. Twelve months' supply of electricity stores. The Clerk, Town Hall, Ballsbridge, Co. Dublin.

Portsmouth.—February 6th. Tramways Committee. Six months' supply of stores, including several electrical items. See "Official Notices" January 26th.

Salford.—February 12th. Miscellaneous stores for Tramways Department. General Manager, 32, Blackfriars Street.

South Africa.—Durban.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Posts and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" January 19th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—By way of Government support to Australian industries, the Postmaster-General's and other Federal Government departments for the next ten years, the Minister of Defence stated on December 6th in the Senate, are to get all their supplies of copper goods from Metal Manufactures, Ltd., as far as it can supply the articles required. This company proposed to erect works at Port Kembla, N.S.W., for the utilisation of Australian metals in the manufacture of electric cables and general copper manufactures.—*Melbourne Age.*

Ilford.—U.D.C. Accepted offers of coal :—

Oakley, Sollas & Co., Ltd., 200 tons Nailstone 1½ in. main nutty slack, at 20s. 3d. per ton; A. Blackman & Co., 600 tons Nailstone 1½ in. main nutty slack, over 12 months, at 19s. 7d. per ton; 50 tons of Measham nuts, 1½ to 2½ in., at 25s. 2d. per ton.

London.—Hammersmith.—The Electricity Committee has accepted the tender of Messrs. Cory Bros. & Co., Ltd., for 50 tons of Hucknal High Hazel ¾-in. slack, at 21s. 8d. per ton, and 50 tons of Gedling High Hazel ½-in. slack, at 18s. per ton.

Islington.—The B.C. has arranged coal supplies as follows :—

A. Blackmore & Co.—5,000 tons Whitwood Silkstone beans, at 22s. 2d. per ton in the Council's wagons.

Myers, Rose & Co.—3,500 tons Shipley double-screened nuts, at 21s. 11d. per ton in the Council's wagons; or in lieu thereof any of the following coals: Manners, Mapperley, Stanley, West Hallam, or Wingfield Manner small nuts.

Cleeves Western Valley Anthracite Collieries, Ltd.—8,000 tons Mapperley Collieries double-screened nuts, at 21s. 1d. per ton in the Council's wagons.

Bowater & Sons.—6,000 tons of double-screened nuts from the Moira Collieries, at 22s. 5d. per ton in the Council's wagons.

The electrical engineer reports that the prices of coal, having regard to the quality thereof, are somewhat lower than those paid for the year 1916. With regard to materials and stores required in connection with the undertaking, the Lighting Committee holds that no useful purpose would be served in advertising for tenders for the year 1917. The electrical engineer is to arrange to continue the contracts or to take other means to secure supplies.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, February 2nd. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Supply of Gaseous Energy," by Dr. C. Carpenter.

Institution of Civil Engineers of Ireland.—Monday, February 5th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Roentgen Society.—Tuesday, February 6th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment. Paper on "Some Properties and Applications of Selenium," by Mr. E. E. Fournier D'Albe.

Liverpool Engineering Society.—Wednesday, February 7th. At the Royal Institution, Colquitt Street. Paper on "The Gladstone Dock," by Mr. W. Hemming Jones and Mr. W. A. Oglethorpe.

Institution of Electrical Engineers.—Thursday, February 8th. At 8 p.m. Paper on "Frequency Changers," by Mr. R. Townend.

(Western Local Section).—Monday, February 5th. At 5 p.m. At Merchant Venturers' Technical College, Bristol. Paper on "The Parallel Operation of Electric Power Stations," by Mr. J. S. Peck.

Greenock Electrical Society.—Thursday, February 8th. At 7.45 p.m. At 22, West Stewart Street. Paper on "H.T. Conduit Systems," by Mr. H. J. Roberts.

Salford Technical and Engineering Association.—Saturday, February 10th. At 7 p.m. At the Royal Technical Institute, Peel Street. Paper on "Modern Iron Foundry Practice," by Mr. W. Rawlinson.

NOTES.

Federated Employers.—Sir Charles D. Macara has retired from the presidency of the Employers' Parliamentary Association. At the annual meeting of the Association, held at Manchester, he said that he had hoped that the forward movement which he had advocated for so long—a federation of employers' organisations of the United Kingdom—would be formed on thoroughly democratic lines, the funds for which would be supplied by levies *pro rata* in the same way as other successful organisations had been carried on. But the Association thought otherwise, and he could not acquiesce in the departure they had decided upon. For that reason he would be glad to be relieved of what had been an arduous task. A resolution was passed approving of the amalgamation of the Employers' Parliamentary Association with the Federation of British Industries. It was agreed that there should be a flat rate of subscription, each of the Associations joining the Federation being required to pay £100 for three years.—*Morning Post.*

The Metric System.—On January 25th Mr. E. C. Barton read a paper before the London Chamber of Commerce, advocating the adoption of the metric system of weights and measures in order to facilitate British trade expansion after the war. Lord Desborough, who presided, emphasised the importance of the matter, and a lively discussion followed the paper. Mr. J. H. Skelton illustrated the defects of our existing measures by reference to the extraordinary variety of definitions of the "quarter" of grain, which differs not only between Government Departments, but also with the country of origin and with the kind of grain concerned.

At a meeting of the London City and Midland Bank on the following day, the chairman, Sir Edward Holden, said that one of the greatest hindrances to the extension of our foreign trade was the use of English measures and coinage in commercial quotations. If we were to extend our trade in countries where German influence had hitherto prevailed, we must adopt systems that were most easily understood by purchasers, and he regarded the use of the metric system of weights and measures, together with a decimal monetary system, as of the first importance.

A Bill is to be introduced into the next session of Parliament, with the support of the Association of Chambers of Commerce, for the adoption of a decimal system of coinage, and if this passes into law, as is confidently expected, it is intended to follow it up with a Bill for the adoption of the metric system of weights and measures. The coinage proposals favour the florin as the monetary unit divided into 100 cents, so that all existing gold and silver coins will remain unchanged in value; the cent will be worth $\frac{24}{25}$ of the present farthing. This system is essentially the same as that which we have advocated, in which the sovereign is divided into ten florins and 1,000 mils; indeed, the only material difference lies in the name of the cent or mil.

The Weights and Measures Bill will not make the use of the metric system compulsory in manufacturing processes, but only in sales.

Development of Empire Resources.—An influential Committee has been formed under the title of the Empire Resources Development Committee with the following objects:—(1) To advocate (*a*) the conservation for the benefit of the Empire of such natural resources as are, or may come, under the ownership or control of the Imperial, Dominion, or Indian Governments; (*b*) the development of selected resources of the Empire under such conditions as will give to the State an adequate share of the proceeds; (*c*) the appointment in due time of a Board for the conservation and development of the resources of the Empire, so that Imperial effort may be concentrated on assets ripe for development for the common good of the Empire. (2) To take such action as may from time to time appear to be desirable in order to disseminate information in regard to the objects of the Committee, to arouse and maintain public interest, to enlist public sympathy and support, and to co-operate with other Committees and Associations having similar objects.

British Trade with Canada.—Before leaving Canada for his coming official tour in the United Kingdom to discuss with British manufacturers the opportunities for the development of British trade in Canada, Mr. Hamilton Wickes, H.M. Trade Commissioner, issued a statement to the Press (says Reuter) expressing his opinion that there is a valuable market there for an increasing quantity of British manufactures and products of the Empire generally. He points out, however, that the British are not as well situated for developing their trade in Canada as the Canadians are for developing theirs in the British Isles. "This disparity is not the fault of the Canadians, but is caused by the laws relating to insolvency, to the incorporation of companies and to trade marks, and also by Customs regulations. There is a strong tendency, he says, on the part of business men in Canada, and in particular of architects, engineers, accountants, and contractors to favour the United States. Mr. Wickes believes that this state of affairs urgently calls for amelioration in the national interest." This is a matter which is by no means unfamiliar to electrical men, who will be fully in agreement with Mr. Wickes in regard to the need for amelioration.

Norwegian Water Power.—A Committee of the Storthing has requested the Norwegian Government not to allow, in future, foreigners or foreign companies to acquire Norwegian waterfalls, except in special circumstances.—*Times.*

National Insurance (Part II) (Munition Workers) Act, 1916.—Decisions by the Umpire:—

Contributions are Payable in respect of:—

2,107 X. Workmen engaged wholly or mainly in shrinking iron hoops on to the ends of cast-iron pipes. (Application 483.)

2,102 X. Workmen engaged wholly or mainly in making metal reflectors for lighting purposes.

Contributions are Not Payable in respect of:—

2,104. Workmen employed by water companies and engaged in attending to the operation of water-softening plant.

Brown Coal Deposits in Australia.—According to the *Melbourne Age*, a deputation from the Institute of Victorian Industries waited upon the Premier, in December, to urge upon him the development of a scheme for the utilisation of the brown coal deposits of the State. The deputation included Prof. Payne, Messrs. A. M'Nicol and T. J. Greenway, consulting engineers; H. R. Harper, City Council electrical engineer; D. Clark, Chief Inspector of Technical Schools; A. H. Merrin, Chief Inspector of Mines; F. H. Bathurst, and J. Stephens, secretary to the Institute. The interview was held in private. Resolutions were submitted for the consideration of the Government, as follows:—

1. That the brown coal deposits of Victoria are of vast extent, and it having once been demonstrated that brown coal can be utilised at a cost to compete with black coal (on which point the Brown Coal Committee considers the evidence to be very favourable), the power potentialities of these deposits are practically unlimited.

2. That the Institute of Victorian Industries urges the Government to take steps towards the immediate development of a scheme for the utilisation of the brown coal deposits of the State, especially in the direction of (*a*) briquette manufacture; (*b*) power production on a large scale.

3. That a working unit be obtained for the making of briquettes in Victoria. In order that an efficient machine be obtained, a suitable man should be sent to the U.S.A. and elsewhere to make inquiries as to latest practice, and advise as to the most suitable plant. At the same time, inquiries should be made concerning the latest practice and most suitable plant for the winning and utilisation of brown coal for all purposes.

4. That the Commonwealth Government be informed that the Institute of Victorian Industries is considering the question of the utilisation of Victorian brown coal deposits for cheap power, which may be applied to the treatment of zinc concentrates.

The speakers at the deputation dealt with various phases of the subject. The Premier said he was greatly impressed by the valuable suggestions that had been made. They had opened up the question of the utilisation of the brown coal deposits on a larger scale than had been previously anticipated. Owing to the quantity of technicalities surrounding the question, he intimated that he would have the speeches of the deputation and the data presented to him printed, in order that the Cabinet might go fully into the propositions made by the deputation.

Exhibition Promoter's Failure.—Walter Cawood, Ltd., London and elsewhere.—The *Financial Times* reports that under a compulsory winding-up order made in this case, the report of the Official Receiver shows liabilities £11,389, no assets of substantial value, and a deficiency of £21,465 as regards contributories.

The company was formed in 1912, with a nominal capital of £12,000, to carry on business as exhibition promoters. It organised the Shipping, Engineering, and Machinery Exhibition and certain other exhibitions, which had every prospect of success. It was intended to hold the Shipping, Engineering, and Machinery Exhibition in 1914, but owing to the outbreak of war it was postponed to 1917. The Dutch Royal Commission would not agree to the postponement, and demanded repayment of the amount paid by them for space rental. A trust was formed to hold the company's funds until it had been finally decided whether the proposed exhibition should be held or cancelled, but in October last a compulsory winding-up order was made by the Court. The failure of the company is attributed by Mr. F. W. Bridges (one of the promoters) to the outbreak of war, the immediate cause being the action of the petitioning creditors in pressing for judgment. In the opinion of Mrs. Cawood (a director), the failure is due to the company not carrying out its contract with the petitioners and to the extravagance of the managing directors with the company's funds.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Balderton Street, Oxford Street.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding:—

Monday, February 5th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill. 6.30—8.

Tuesday, February 6th.—A volunteer fatigue party is required to assist the Quartermaster.

Wednesday, February 7th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, February 8th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, February 9th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, February 10th.—N.C.O.'s Class, 2.30, under Company-Commander Fleming.

Sunday, February 11th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), Macleod Yearsley, *Adjutant.*

Fatalities.—The adjourned inquest was held last week, at Bradford, on Miss Jeannie Kathleen Regan, the conductress who lost her life in the recent tramway collision near Wyke, when a car, which slipped its brakes at a hilltop terminus, ran into another car going at normal speed in the same direction. The conductress of the runaway car (Mrs. Eva Haryott), who had been alone on the car—the driver being absent delivering a message—gave evidence that she knocked off the hood switch to cut off the current, and then pulled over the air and oil brake, but that did not seem to make any difference to the speed. She found she could not move the hand brake, and therefore assumed it must have been already on. She eventually jumped off the car. She gave evidence on the advice of her solicitor, to refute rumours in the district that she had been "playing about" with the brakes whilst the cars was at Wyke. As a matter of fact, she was on top changing the indicators. There was another rumour that she and the driver had disappeared together. The Coroner said these rumours had led him to adjourn the inquiry, so that anybody who knew anything could come forward, but nobody had done so. The witness said her instructions were not to touch the brakes except in emergency. The oil brake was simple. When she put on this brake she did not release the clip, and it slipped back. On the second occasion it did the same thing. In answer to a question as to why she had not released the clip, she agreed that she was upset and a bit flurried. The jury handed in written replies to questions asked by the Coroner. They found that the brakes had been put on, but not tightly enough to hold the car against the high wind. They did not believe anyone had taken off the brakes, or that the car would have started by itself if the brakes had been properly applied. There had been a degree of negligence on the part of Driver Hudson, deserving censure, but it was not of a criminal character. The jury recommended that more practical tuition should be given to conductresses regarding the application of brakes, and that a more efficient method should be adopted when drivers were changing ends. Conductresses should have practical tuition in brakes. Mr. C. J. Spencer, Bradford tramways manager, said he did not know in what way the method of learning could be improved. If it was possible to put each conductress on a car before turning her out it would be done. The jury said they did not suggest inefficient training of conductresses, and thought Mr. Spencer's promise would meet their wishes. The Coroner hoped the case would be a lesson to the driver, and he would pass it on to other drivers if he saw them leaving their cars. Hudson promised to do so.

At Smethwick, last week, at an inquest into the death of Thomas E. Thompson (40), coal trimmer at the Smethwick power station, the jury returned a verdict of "Accidental death." It appeared from the evidence that Thompson overbalanced and fell into a hopper while shovelling coal from a hopper which was out of use, into one which was charging the boilers. He was buried in slack, and it was 20 minutes before his body could be got out.

The A.S.E. and Trade Union Rules.—In his references to the Manchester Conference, the *Times* Special Correspondent said that not the least important of the resolutions submitted reminded the Government of the pledge to restore Trade Union rules and conditions after the war, and called on the Government to prevent any evasion of its pledge by unscrupulous employers. "The resolution does not explicitly demand immediate restoration. It may, perhaps, be regarded as a statement of an unquestionable right rather than the declaration of a final decision. In this connection one notes that the Amalgamated Society of Engineers, in a resolution of their own, add to an affirmation of the right to complete restoration a frank recognition that, owing to permanent industrial changes during the war, it may not in all cases be practicable to secure absolute and literal restoration of every Trade Union custom. The resolution goes on to declare that if good reason can be shown for regarding restoration as impossible, and if new, and at least equivalent, concessions are given to the Unions, Labour will be ready for negotiation on the matter. How far this attitude on the part of the Union most vitally concerned will commend itself to the Party as a whole, remains to be seen, but the submission of the resolution is, in itself, one of the most striking fruits of the foresight and innate common sense by which the responsible Labour movement is justified."

At the meeting, Mr. J. T. Brownlie, representing the Amalgamated Society of Engineers, moved the following resolution:—

"That this Conference, believing that the attempt to negotiate a binding industrial truce between Labour and Capital might well create more friction than it would prevent, cannot regard the conclusion of such a truce as either practicable or desirable; but that this Conference would welcome the initiation of negotiations between Trade Unions and Associations of Employers in each industry with a view to the settlement by agreement, wherever possible, of the serious industrial problems that will arise after the war. This Conference, therefore, re-affirms its belief in the pre-war methods of negotiation between employers and employed, and affirms its opposition to any system of compulsory arbitration in trade disputes."

The engineers recognised, Mr. Brownlie said (according to the *Times* report), that it would be in the interest of all parties that, at the end of the war, the country should be free from industrial strife. They would welcome negotiations between employers and employed for the settlement of any differences which might arise. But they were not willing to place any difficulties in the way of the use of the strike weapon as a last resort, and they could not accept the principle of compulsory arbitration.

The resolution was rejected by a large majority, and the Conference accepted in its place a plain declaration of hostility to compulsory arbitration.

Localising a Fault.—The following letter has been received:—Being interested in mains work, and having read "Mains Assistant's" letter in your current issue, I venture to suggest a simple, I will not say the best, method of locating a fault such as he describes, which consists of a fall of potential test.

Before doing so, may I be permitted to state that, in my experience in connection with triple-concentric lead-sheathed and armoured cables, nine-tenths of the faults have been found in straight-through or service joint boxes, except in cases where the cable has been damaged. Having proved that all three conductors are shorted and earthed, you must satisfy yourself that no earths are existing on any of the consumers' installations, and I should suggest, in this case, the withdrawing of all the consumers' fuses before carrying out the test.

The apparatus required is a variable resistance (usually a bank of lamps), capable of passing anything from .25 to 3 amperes, and a millivoltmeter with a range of 0-500.

In this case it will be necessary to take a test from each end of the feeder, care being taken that the ends not in use are left entirely disconnected.

The method of procedure is to pass a suitable current from one end A to the fault, say, *viâ* the positive conductor, using either the negative or neutral conductor as a test wire. The

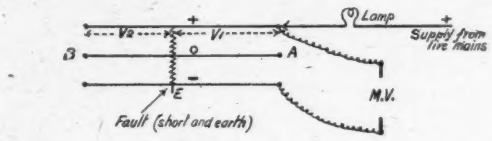
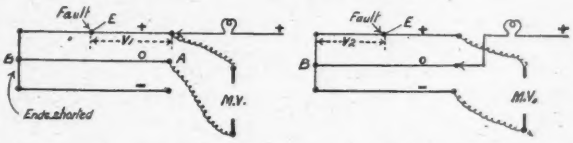


FIG. 1.—TESTS FOR SHORT AND EARTH ON ALL THREE CONDUCTORS.

same amount of current is then passed through to the fault from the other end B, which must be *viâ* the same conductor as in the first test, a note of the readings, of course, being taken.

The distance of the fault from A, which is the end first tested, is obtained from the following formula: $L \times V_1 \div (V_1 + V_2)$ = distance of fault from A, where L denotes the total length of the feeder in yards, and V_1 and V_2 the first and second tests respectively.

If only one conductor had been earthed, and no short circuit, it would only have been necessary to test from one end, with the three conductors shorted at the opposite end, as will be seen from the following diagrams:—



First Test. Second Test.

FIG. 2.—TESTS FOR EARTH WITHOUT SHORT ON ONE CONDUCTOR ONLY.

Having calculated the distance, it may be found that the test brings you within 2 yd. of a straight-through or service joint box, which, of course, one would naturally open out.

I do not say it is correct to within a foot, but I have located something like 100 faults on concentric mains with the above tests, and the farthest I have been away is 3 yd. on lengths varying from 50 to 700 yd.

The only time that I find this test difficult to apply is when there happens to be two earths at different points on the same conductor, or when there is excessive leakage from any tramway rails where they run parallel to the cable and the ordinary street distance away.

However, my experience teaches that if you have a sensitive dead-beat instrument, and always clean contacts at the testing points, with fairly heavy testing cables, the above test will not lead you very far astray.—P. WARDLE, Carlisle, January 28th, 1917.

British Tungsten Ores.—Some specimens of the important tungsten ores, wolframite and scheelite, have been received at the Imperial Institute from the Federated Malay States. Wolframite, commonly called wolfram, which forms the bulk of the tungsten ore produced, occurs in various parts of the main mountain range in British Malaya, and in Pehang and Trengganu. Scheelite is mined in Perak and Selangor.—*The Times.*

Russian Electrical Energy Tax.—The proposal to impose a tax on electrical energy is once more before the Council of Ministers. The Minister of Finance has submitted his conclusions on the views of the departments that had expressed themselves against various features in the project. The most pronounced objection was that of the former Minister of the Interior, Chvostoff, who found that the taxation of electric lighting in private rooms, along with kinematographs, places of amusement, and business premises, at the rate of 4 copecks per KW.-hour, was unfair, onerous, and inopportune.

Technical Works for Men on Active Service.—We are indebted to the Chloride Electrical Storage Co., Ltd., for a set of their excellent pamphlets on accumulators, for transmission to our correspondent, Corporal S. J. Knight, with the Mesopotamia Expeditionary Force.

Irish Coalfield Development.—In connection with the proposed development, under State aid, of the Wolfhill (Queen's Co.) anthracite coal area, the scheme provides for the erection of a central station at which would be placed suction engines and plant to generate electricity for hauling, winding, pumping, coal cutting, and the driving of aerial ropeways.

Engineers' Wages.—The Clyde District Committee of the Amalgamated Society of Engineers yesterday made application to the Employers' Federation for an advance of 4d. per hour. This is the largest claim ever made by this Society, and is their fourth since the outbreak of war. Up to the present time they have received advances equal to 1¾d. an hour.—*Daily Telegraph.*

Institution and Lecture Notes.—Roentgen Society.—At the next meeting Dr. Fournier d'Albe, Physicist to the Board of Inventions and Research, is to demonstrate his type-reading optophone, by which blind persons are enabled to read ordinary letterpress by ear. This is done by audible telephone currents, produced by intermittent light of various musical frequencies. The printed sheet is passed over a slab with an aperture, upon which a horizontal beam of light is projected from an illuminated disk, and by means of a set of selenium bridges exposed to light reflected from the type, sounds which vary with the shape of each letter are produced and carried through the telephone. The inventor states that the alphabet can be learned in three or four days, and with practice a speed of 25 or more words read per minute can be acquired. Dr. Fournier d'Albe also proposes to show other properties and applications of selenium, including its direct action in which one lamp is made to light another without a relay.

The meeting will be held at the Institution of Electrical Engineers on Tuesday next, at 8.15 p.m. Visitors interested in the subject will be welcomed on this occasion.

Institution of Electrical Engineers.—The following meetings are announced to be held in London :—

February 8th.—R. Townend, "Frequency Changers."
March 8th.—G. A. Juhlin, "Voltage Regulation of Rotary Converters."
March 22nd.—F. R. McBerty, "Machine Switching Telephone Gear."
April 12th.—Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier.
April 26th.—G. V. Twiss, "High-Tension Overhead Transmission Lines."
May 17th.—Annual general meeting.

Inquiries.—Makers of the "Hofmann" connector for bare wires are asked for. This is a metal sleeve with two transverse holes; the wires being laid in the sleeve side by side, a drift is driven through each hole between them, forcing them into recesses in the sleeve, and afterwards rivets are put through the holes and closed.

A correspondent inquires the name of the present maker of the "Float" electric lamp. It is required for shipyard use.

Sale of Siemens Shares.—The Public Trustee will shortly offer for sale by public tender 119,660 shares of £5 each, fully paid, in Siemens Bros. & Co., Ltd. An announcement on the matter appears in our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Rochdale Corporation Gas and Electricity Committee last week accepted the resignation of Mr. C. CLARE ATCHISON, the borough electrical engineer, owing to continued indisposition. In November last Mr. Atchison was given leave of absence, owing to a breakdown in health, and this was extended a month later. He went to Rochdale from the South of England in 1900 as clerk of works in connection with the electricity undertaking, which was then being started, and became the electrical engineer, having also the tramways under his supervision in the early days.

The Southampton T.C. has decided to advance the salary of the tramways manager, Mr. ROBSON, from £400 to £500 a year.

Mr. J. MCELROY, general manager of the Manchester Corporation tramways, has been granted leave of absence in order to take up work under the Admiralty in connection with the organisation of shipyard labour at the request of the Government. Mr. McElroy organised the conveyance of workmen to and from munition works in London.

At the Town Hall, Ilfracombe, recently, Mr. ALFRED RUDD, who is on the staff of the Ilfracombe Electric Light & Power Co., Ltd., having been relief stoker and mains man since 1910, was publicly presented with the Royal Humane Society's bronze medal and certificate of honour for conspicuous bravery in saving the life of Dorothea Thorne at Cheyne Beach. Mr. Rudd had previously saved four or five persons from drowning, and had been awarded certificates from the Society. The rescue for which the medal mentioned was granted was a very plucky one. A girl was washed off the steps by the sea at high tide, and would have been drowned had not Mr. Rudd dived in. The sea at the time was too rough to allow a landing near, and he had to swim with her a considerable distance.

General.—The Dublin Corporation Electricity Supply Committee has re-elected Coun. J. J. O'NEILL chairman for the ensuing year, and Coun. L. SHERLOCK deputy-chairman.

Mr. JOSEPH MALLAGH has been appointed engineer to the Dublin Port and Docks Board, on probation for 12 months, at a salary of £650.

The Western Mail says that Mr. JAMES DAVIES, chief electrical engineer, received a severe shock at Llandebie Colliery, but recovered consciousness under treatment.

The following announcement appeared in the *London Gazette* on January 24th :—"Royal Engineers: Second-Lieutenant (Temporary Lieutenant) CLYDE HIGGS to be Temporary Captain."

Roll of Honour.—Lieutenant F. E. JONES, R.E., engineer to the Tyldesley (Lancs.) District Council, has been mentioned in dispatches by Sir Douglas Haig for some excellent work in France.

Private C. B. CROSSBY, Royal Warwickshire Regiment, who has died of wounds received whilst acting as a stretcher bearer, enlisted from the carbon lamp department of the British Thomson-Houston Co., Ltd., of Rugby.

Sapper G. TILLEY, of the Royal Engineers, who has been awarded the D.C.M., was before the war a telegraphist at the Leeds General Post Office.

Corporal J. CHADWICK, Lancashire Fusiliers, who has been killed in action, was an electrician at Messrs. Bibby and Baron's, Bury. He was 35 years of age.

Sergeant JAMES SMITH, Scottish Rifles, who was employed in the permanent-way department of Blackburn Corporation tramways, was wounded in the Loos battle, and had been awarded the Military Medal for assuming command of his company when all the officers had fallen, has been killed in action.

Sergeant P. GALLEY, of the York and Lancaster Regiment, of the Leeds city tramways department, has been awarded the D.C.M.

The *Times* reports that Lieutenant H. R. HELE-SHAW, R.F.C., previously reported missing on July 19th last, now unofficially reported shot down in aerial action with his machine and killed, aged 20 years, was the only son of Dr. and Mrs. Hele-Shaw, of Coleherne Court, S.W.

Lieutenant T. S. H. SCHAFER, Northumberland Fusiliers, younger son of Sir Edward Schäfer, Professor of Physiology in Edinburgh University, who has been missing since September, 1915, is now officially assumed to have been killed.

Company Sergeant-Major JAMES SCOTT, Royal Irish Rifles, killed in action, was in the service of the Belfast tramways before the war.

Obituary.—MR. J. TODER.—The death occurred on January 22nd, at Hale (Ches.), of Mr. John Toder, late Australian representative for Messrs. Belliss & Morcom, Ltd. He was in his 51st year.

NEW COMPANIES REGISTERED.

British Switchgear, Ltd. (145,852).—Private company. This company was registered on January 25th, with a capital of £40,800 in £1 shares (40,000 pref.), to carry on the business of manufacturers of and dealers in electrical switchgear, switchboards, and other electrical and mechanical machinery and apparatus, &c., and to enter into an agreement with Brook, Hirst & Co., Ltd., and Erskine, Heap & Co., Ltd. The subscribers (with one ord. share each) are: J. M. Scott Maxwell, Baillieston House, Baillieston, Lanarkshire, electrical engineer; H. C. Siddeley, 66, Foxley Lane, Purley, Surrey, electrical engineer; J. A. Hirst, Douacloney, Deganwy, North Wales, electrical engineer; A. Erskine, Brantwood, Oak Drive, Fallowfield, Manchester, electrical engineer. The first directors (to number not less than two or more than seven) are: J. A. Hirst (nominee of Brook, Hirst & Co., Ltd.), J. M. Scott Maxwell (nominee of Electric Control, Ltd.), A. Erskine (nominee of Erskine, Heap & Co., Ltd.), and H. C. Siddeley. A member holding 120 ord. shares may from time to time appoint and remove a director. Qualification, one ord. share. Remuneration (except managing director), as fixed by company. Solicitor: T. M. Dutton, 19, Newgate Street, Chester. Secretary: H. C. Siddeley.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Miniature Electric Vehicles, Ltd.—Particulars of £3,000 debentures, created January 17th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Duroglass, Ltd.—Issue on January 12th, 1917, of £300 debentures, part of a series of which particulars have already been filed.

Keynsham Electric Light Co., Ltd. (64,634).—Capital, £5,000 in 3,000 pref. and 2,000 ord. shares of £1 each. Return dated December 19th, 1916. All shares taken up; £5,000 considered as paid. Mortgages and charges: £2,980.

Masham & District Electric Supply Co., Ltd. (138,306).—Capital, £2,000. Return dated May 18th, 1916 (filed August 25th). 902 pref. and 500 ord. shares taken up; £1,082 paid on 902 pref. and 180 ord.; £320 considered as paid on 320 ord. Mortgages and charges: £220.

Electric Zinc Co., Ltd. (127,838).—Capital, £2,000,000 in 400,000 pref. and 1,600,000 ord. shares of £1 each. Return dated December 31st, 1916. Seven shares taken up; nothing called up. No directors have been appointed. Mortgages and charges: Nil.

Aron Electricity Meter, Ltd. (58,650).—Capital, £350,000 in 225,000 ord. and 125,000 pref. shares of £1 each. Return dated January 2nd, 1917. 125,000 ord. and 125,000 pref. shares taken up; £124,948 10s. paid on the pref., including £53 10s. on 104 forfeited shares; £125,000 considered as paid on the ord. Mortgages and charges: £96,600.

East India Tramways Co., Ltd. (74,457).—Capital, £100,000 in 15,000 pref., 35,000 ord., and 50,000 def. shares of £1 each. Return dated December 15th, 1916. 7,500 pref., 33,433 ord., and 50,000 def. shares taken up; £1 per share called up on 7,476 pref. and seven ord.; £7,489 paid, including £6 on 24 pref. shares forfeited; £83,426 considered as paid on 33,426 ord. and 50,000 def. shares. Mortgages and charges: Nil.

Delagoa Bay Development Co., Ltd. (76,099).—Capital, £166,300 in 10s. shares. Return dated December 5th, 1916. 267,400 shares taken up; 10s. per share called up on 177,400; £88,720 paid; £45,000 considered as paid on 90,000 shares. Mortgages and charges: £188,900.

Northampton Electric Light & Power Co., Ltd.—Issue on January 2nd, 1917 (at 20 per cent. discount) of £1,835 debs., part of a series of which particulars have already been filed.

Pernambuco Tramways & Power Co., Ltd.—Supplemental to trust deed dated January 19th, 1917, modifying trust deed of August 11th, 1913, and extending time for repayment of £1,250,000 debs. secured thereby.

National Electric Construction Co., Ltd. (53,364).—Capital, £125,000 in 10s. ord. shares. Return dated September 6th, 1916 170,000 shares taken up; 10s. per share called up on 151,149; £75,574 10s. paid; £9,425 10s. considered as paid on 18,851. Mortgages and charges: £75,000.

Northern Engineering & Construction Co., Ltd. (95,550).—Capital, £3,000 in 2,940 ord. and 60 founders' shares of £1 each. Return dated December 30th, 1916. 1,305 ord. and 40 founders' shares taken up; £305 paid; £1,040 considered as paid. Mortgages and charges: Nil.

CITY NOTES.

East London Railway Co.—During the year ended December 31st the number of passengers carried was 9,358,000, against 8,519,880. At the previously ascertained average rate of 1.27d. for each passenger, the traffic from this source should now yield over £49,500 per annum. Owing to the position of the company as affected by conditions formulated under Government control of railways, it appears that only a portion of the interest accruing on electrification capital will be recoverable. This will affect the company's interests and those of the stockholders prejudicially. The Government, having benefited by the great increases in passenger traffic, are being approached by the directors with a view to the company's case being specially dealt with; that is, by recouping them the amount due and becoming due in respect of the contingent liability for interest on capital expenditure on the electrification of the railway.

Chatham & District Light Railways Co.—For the year ended December, 1916, the revenue was £64,567, and the expenses were £34,341, leaving £30,226. There are deducted rent of Corporation lines, interest on debentures, amount written off investments (£1,330), reserve for depreciation (£6,000), maintenance reserve (£2,000), and other items, amounting in all to £15,975, leaving £14,251, plus £3,150 brought forward. After paying the preference dividend, and a total of 7 per cent. for the year on the ordinary, £307 is payable to the directors, leaving £3,794 to be carried forward. There was an increase of £3,650 in revenue and £2,111 in expenses as against 1915. It has again been impossible, owing to shortage of labour and difficulty in obtaining materials, to maintain the track and rolling stock in the usual state of repair, and £2,000 has been added to maintenance reserve account in order to make some provision for the repairs which will have to be undertaken when the war is over. During the year £17,500 debentures have been purchased and redeemed. Annual meeting: February 12th.

Metropolitan Railway Co.—Dividend upon the ordinary stock for the past half-year at the rate of £1 per cent. per annum, making 1 per cent. for the year, and carrying forward about £14,500, after placing £20,000 to the general renewals fund. Dividend on the Surplus Lands stock at the rate of 2¾ per cent. per annum, carrying forward £2,600, after placing £3,800 to reserve accounts.

Russia.—The E. A. Englund Telephone Equipment Bureau, Moscow, is being formed, with a capital of 1,000,000 roubles.

Westminster Electric Supply Corporation, Ltd.—The directors recommend, subject to final audit, a dividend at the rate of 9 per cent. per annum, less income-tax, for the last half-year (making 7 per cent. for the year).

STOCKS AND SHARES.

Tuesday Evening.

Little is heard in the Stock Exchange nowadays except on such matters as those concerning the new War Loan. This week the time has expired for taking advantage of the Treasury's offer of 3s. 4d. per cent. extra interest to those who paid in their money up to three o'clock on January 31st. Probably next week will be a quiet one, so far as the loan is concerned, and then there will be a grand rush at the finish, with cumulative excitement day by day until February 16th has come and gone. During this period, the remainder of the markets round the House are bound to suffer more or less from the general influence of the loan. A side-issue which receives a certain amount of attention in the markets at the moment is whether the Stock Exchange will be classed as a non-essential industry when the official pronouncements are made. The odds at present favour the idea of its being deemed essential.

The first of the Home Railway dividends made its appearance at the end of last week in the shape of the Metropolitan. The company has declared a dividend of ½ per cent. actual, making 1 per cent. for the year, the same as that for the previous 12 months. The balance forward is £1,500 up, and the renewals fund gets an extra £5,000.

The other dividends which have been declared during the past few days are all on practically the same lines as those of a year ago; and so far as the Heavy stocks are concerned, prices have reacted until they stand now at what is nearly a 7 per cent. basis of yield. As the Metropolitan pays about 4¼ per cent. on the money, the proprietors may have the proud feeling that, judging by the price alone, their stock commands a higher credit than Consols or the new War Loan! The Surplus Lands stock remains at 46, and Metropolitan deferred dividend stock dropped a point to 19.

Underground Electrics were somewhat pressed for sale by those who had bought the bonds cheaper, were prepared to take their profit, and to re-invest the money into the popular stock of the moment. When these sellers had been disposed of, the price recovered from 89 to 89½, which still leaves it lower on the week. The £10 shares remain in the neighbourhood of 2, and the 1s. shares are a trifle under 6s. Weakness in the pre-ordinary stocks of the Home Railway companies is still noticeable.

The Treasury issued a notice towards the end of last week which came as something of a bombshell to those markets which had been dealing with a fair amount of freedom in securities of the American-Canadian electric power order. The bargains have been almost entirely sales on behalf of holders on this side, the purchasers taking the securities for America. The Treasury, in their latest enactment, lay down that no securities must be shipped from this side without special permission; and this, of course, has brought to a standstill the business which had been going on in the classes of shares mentioned.

The list comprises shares in undertakings which probably not one British investor in 5,000 has ever heard of, but the high levels to which prices have recently been lifted in New York, Washington, and Boston proved too strong a temptation for British holders of the shares to resist; and they have been sending them out in quantities of late. A special meeting of the Stock Exchange Committee was hastily called to decided what ought to be done in connection with transactions that have not yet been settled up; and the matter now rests between the House and the Treasury, awaiting the decision of the latter.

More strength is shown by Brazilian Traction shares, which rose to 50, ex the quarterly dividend of 1 per cent.—equal, of course, to 15s. net. This is due to the greatly improved complexion that Brazilian affairs have assumed on the reaffirmation of the expectation that Brazil will be able to resume cash payments of her debts by next August. Such anticipation has been current for some time past, but none too much credence was place in it. Now, however, the President of Brazil has practically endorsed it; and Brazilians are distinctly better in consequence.

A cross-current is the uncertainty felt with respect to the securities which the Treasury has announced it will requisition from holders in connection with its scheme for regulating foreign exchange. Some surprise is expressed at what looks an arbitrary proceeding on the part of the Government, although the requisition would not have been necessary had holders of foreign securities come forward, as they should have done, to lodge the stocks and shares for which the Treasury asked the deposit voluntarily. Those who refrained from sending in their stocks will find themselves in a much less favourable position, as regards interest and repayment, than those who complied with the earlier request.

The Argentine stocks are steady, but there is no recovery in the British Columbia Electric Railway issues.

The market in electricity supply shares remains extremely placid. There is a little business doing in Cities and Counties; otherwise, the group is without feature. Bargains were marked in the early part of the week in South Metropolitan Electric ordinary round about 17s. 6d.

There are not many changes in the market for telegraphs and telephones. Anglo-American Telegraph preferred is once more better, but the deferred sticks at 22¼. The Eastern group has given way a trifle, Eastern ordinary being a point down at 137, while Globes receded to 12. United River Plate Telephones have again eased off. There is a good deal of quiet selling going on on the part of holders who want to invest into the new War Loan; and although (we are glad to see) some of the papers are beginning to sound a note of caution on this point, the tendency is still for the investor to sell what he has, and to buy the new stock.

That note of caution is necessary, because it does not always follow that a sale of existing stock—especially if made at a heavy sacrifice—is necessarily in the interests of this country; and the rather indiscriminate realisations which have been made on the ground of patriotism may turn out to be less advantageous to the country than the sellers intend. Every case, of course, must be taken by itself. We make no excuse for labouring the point, because it is one of great importance; but every intended transaction should be examined with a good deal of scrutiny before it is carried into effect, lest indirectly it may cause more harm than good.

It is interesting to holders of electric lighting shares to notice that the Gas, Light & Coke Co. is paying a dividend of 4 gs. per cent. in respect of the past half-year, this being at the same rate as for the corresponding six months; but the company has had to take £130,000 from its reserve in order to maintain the distribution.

Babcock & Wilcox shares have gone back 2¾. British Westinghouse preference are easier at 2¼. Castner-Kellner at 3 and Henleys at 15¾ are both a little down, and the usual reason for falls in prices nowadays is sufficient to account for all of these declines.

Industrials as a whole are quiet; there is little doing, for instance, in the rubber market. The price of the raw material keeps steady at about 2s. 10½d. per lb., but the American buyers are holding off—possibly in consequence of the renewed submarine activity started by the enemy. The metal markets are quiet, too. There is a rather better tendency in some of the armament shares, without, however, any particular feature calling for comment.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Jan. 30, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3¾	—	7 8 2
do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9⅞	— ¼	6 3 1
Kensington Ordinary	9	7	6⅝	— 1/32	6 10 3
London Electric	4	3	1½	—	7 2 10
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	3½	3	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	6 19 0
South Metropolitan Pref.	7	7	1 15/16	—	6 7 8
Westminster Ordinary	9	7	5⅝	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	9½	+ ⅛	6 7 2
do. Def.	30/-	33/6	22½	—	6 14 10
Chile Telephone	8	8	7	—	5 14 8
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	13⅞	—	*5 15 4
Eastern Tel. Ord.	7	8	137	—1	*5 16 10
Globe Tel. and T. Ord.	6	7	12	—	*5 16 8
do. Pref.	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	22	87	—	5 19 0
Indo-European	13	13	49	—	6 12 8
Marconi	10	10	2 1/16	—	3 14 9
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2½	—	4 9 0
United R. Plate Tel.	8	8	6 9/16	— 1/16	*6 2 0
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅞	—	*5 15 4
Home Rails.					
Central London, Ord. Assented	4	4	64½	—	6 5 0
Metropolitan	1½	1	23	— ½	4 7 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	89½	—1	*6 14 1
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 1/2	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	8	—	9 4
do. 2nd Pref.	5½	5½	2⅞	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	50xd	+1	8 0 0
Bombay Electric Pref.	6	6	10xd	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	62	—	8 1 4
do. do. Preferred	—	Nil	44	—	Nil
do. do. Deferred	—	Nil	33½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—1	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	22	— 1/16	5 9 1
British Aluminium Ord.	5	7	27 6	—	5 16 8
British Insulated Ord.	15	17½	113	—	7 5 10
British Westinghouse Pref.	7½	7½	2¼	— 1/32	6 13 4
Callenders	15	20	12½	—	7 17 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8 7/16	— 1/16	6 18 0
Edison & Swan, £3 paid	Nil	—	1/16	—	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1 1/16	—	8 0 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	13½	—	7 5 6
Henley	20	25	15¾	— ¼	7 13 9
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*8 0 0
Telegraph Con.	20	20	88	—	*6 5 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 31st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£54	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£34	..
a Copper Sulphate	"	£66	..
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	2/-	..
a Shellac	per cwt.	144/-	2/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	"	£19	..
a " Lump	"	£16	..
a Soda, Chlorate	per lb.	1/-	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/8 to 1/8½	..
g " Bars (best selected)	per ton	£166	..
g " Sheet	"	£166	..
g " Rod	"	£166	..
d " (Electrolytic) Bars	"	£143	£2 inc.
d " " Sheets	"	£171	£11 inc.
d " " Wire Rods	"	£151	£3 inc.
d " " H.C. Wire	per lb.	1/5½	¾d. inc.
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/3	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2½	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£38	..
g Lead, English Pig	"	£33 5	..
g Mercury	per bot.	£19 15	£1 inc.
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/3 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	¾d. dec.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

Callender's Hospital Fund.—The annual report of Callender's Hospital and Distress Fund for 1916 is in our hands. As in previous years, a large amount of useful work in small, but invaluable ways, has been done. The year was a remarkable one in the history of the Fund. Owing to the war, many more of the old members have joined the Forces, and patriotic women have taken their places, and are doing their best to fill the gap and meet the extra requirements in munitions and other work. Thus the subscriptions have been well maintained, and the usual sums have been distributed to the various hospitals. The penny weekly subscription realised £288, against £270 in the previous year. The year's total is £1 6s. 6d. less than the record year of 1903, when the Fund was inaugurated. Callender's Cable Co., Ltd., donated £50, and there were smaller sums subscribed by nine directors and officials. The amount distributed to hospitals, nursing associations, &c., was £281, as against £284 in the previous year, and surgical, spectacle and financial aid was given directly in many cases. The report concludes, "We enter the New Year hoping that before it closes our nation and its Allies will rejoice in a victorious Peace, and our Fund experience further success."

Carbon Electrodes for Arc Furnaces.—In an article on arc furnaces for steel-making in the *Iron and Coal Trades Review*, it is stated that British users are at present dependent upon supplies of electrodes from the United States and Sweden, but a factory has been completed in Sheffield by local firms, and its output is to be doubled immediately. Another factory is being built in the Newcastle district, and will probably be ready in the spring. These factories will produce electrodes of amorphous carbon, and users of graphite electrodes will still be dependent on the Acheson plant at Niagara Falls. While power at the Falls costs £5½ per KW.-year, it has been supplied by certain works in this country at £4½ per KW.-year.

Benzol and Electricity.—In the course of a paper recently read before the Midland Institute of Mining Engineers, on The Rectification of Benzol," the author stated that there seemed to be no doubt that an electric potential was created by the rapid passage of benzol through a narrow pipe, and he consequently urged that all pipes used in conveying benzol should be properly earthed.

THE FILTRATION OF AIR.

One of the most important applications of filtered air is for cooling turbo-generators. These machines are small in size in proportion to their output, and have, consequently, a limited space wherein only comparatively small air channels can be provided for the dispersion of the heat. Since the introduction of mechanically-ventilated generators it has been found that the use of unfiltered air has a deteriorating effect on the insulation, owing to the presence of dirt and dust particles in the atmosphere, which are gradually deposited on the windings, causing local overheating and eventual breakdown of the insulation. The abrasive action also of many thousands of minute dust particles impinging on the end windings wears away the varnish and insulating fabric, with the result that when the machine, in such a condition, cools down in an atmosphere of ordinary humidity, the end windings rapidly absorb moisture, causing serious and unexpected "burn-outs." The importance of filtration is still more evident when the large amount of air required for ventilating large turbo-generators is taken into account. For instance, a moderately large generator would use 20,000 cb. ft. of air per minute, which means a total of 28,800,000 cb. ft. per day of 24 hours. As a rough approximation, it may be assumed that one hundred-millionth of the volume of the air in the vicinity of power plants consists of dust, dirt, and other foreign particles. This would mean that 87 cb. ft. of dust would be blown into the machine during a year of 300 working days. While, of course, the great bulk of this dirt would pass directly through the machine, a portion would be deposited in the air passages, due to the air swirls and eddies. Such deposits of dirt become a considerable handicap to ventilation, as the quantity of air is decreased, due to the partial closing of the ventilating passages, and the cooling effect of the air is greatly diminished, owing to the fact that the air cannot come directly into contact with the heat radiating surfaces.

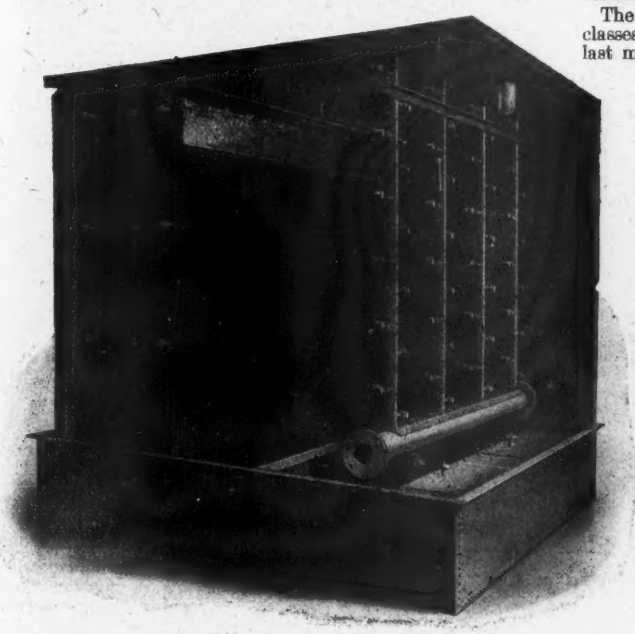


Fig. 1.—Sirocco Air Washer, Side Plate Removed.

The above advantages of filtered air apply also in the case of forced or pipe-ventilated motors working in a dusty atmosphere. However well they may be protected, the presence of grit and dust in the atmosphere has a destructive effect, not only on the windings, but also on the bearings. By using purified air, the dusty atmosphere is prevented from entering the motor, thereby prolonging its life and allowing it to operate under the most ideal conditions irrespective of its surroundings.

Filtered air is also valuable in the case of air-compressors, as the admission of gritty and dusty air plays havoc with the valves and cylinders, causing trouble and expense, and resulting sometimes in a serious breakdown. Particularly is this the case when the compressor is installed at a colliery, where the general atmosphere contains a large proportion of coal dust.

Dry air filters consist of cloth or fibre screens, while in the wet type of filter the purification is effected by passing the air current through a fine water spray. The dry filter takes up more space than a wet one, and where cloth screens are used there is also the risk of fire. Further, in the dry type, the maximum quantity of air passes through only when the filter is clean, and gradually lessens as the cloth becomes choked up, thereby setting up more resistance to the free flow of the air. These filters also require to be cleaned frequently, which can usually only be accomplished when the machine is out of action.

In the wet type of filter the air is thoroughly washed by passing the air current through a chamber filled with a very fine mist, which causes the bulk of the solid matter suspended in the air to be precipitated into the tank at the base of the machine. The air, after leaving the spray chamber, encounters a battery of scrubber plates, on which any dust or dirt remaining in the air is deposited, and then passes on to a series of eliminator plates, by means of which it is buffeted from side to side, depositing during this process any free moisture upon the eliminators, and leaving the washer in a thoroughly clean and cooled state, with no trace of free moisture. We illustrate in fig. 1 a Sirocco air washer made by Messrs. Davidson and Co., Ltd., of Belfast; the side plate has been removed, showing the spray chamber and the series of scrubber and eliminator plates, which are more clearly seen in fig. 2. In this filter the resistance to the air current is constant, thus allowing the same volume to pass all the time, and as the resistance is low, less fan power is required to pass a given volume of air than in the case of a dry filter. It is also easily cleaned while in operation. The water consumption is very low, as it is recirculated by means of a pump, passing through two sets of filters, so as to prevent any dirt choking the spray nozzles. It is claimed that this washer will remove 98 per cent. of solid matter from an impure atmosphere, and will deliver the air without any free moisture and in a cooled state.

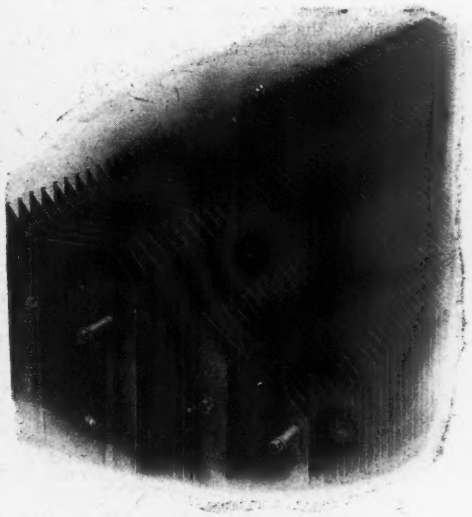


Fig. 2.—Scrubber and Eliminator Plates.

RURAL TRANSMISSION LINES.

In a paper read before the Portland, Ore., Section of the National Electric Light Association and American Institute of Electrical Engineers, by Mr. A. S. Hall, the economical construction of lines in rural districts was discussed.

The author says that new business can be divided into three classes: (1) Competitive, (2) development, and (3) rural; the last may eventually become a large proportion of the total.

Up to the present it has not been sought after to any great extent by organised methods, because its possibilities have not been realised, and there was apparently more remunerative business nearer home.

Practically every town in the Pacific North-West is surrounded by an agricultural community, with, in many cases, a population nearly as large as the city itself.

In Hood River County 37 per cent. of the population served is outside the city limits of Hood River; this 37 per cent. furnishes 38 per cent. of the company's supply revenue; it is a safe assumption that when 50 per cent. of the population served is outside the city limits, over 50 per cent. of the gross revenue will come from rural business, because such consumers use more electricity than town consumers.

On the other hand, this 37 per cent. of business uses 51 per cent. of the operating expense; furnishes only 10 per cent. of the revenue from operation, and about one-third of 1 per cent. of the net operating income.

Each class of business is made to stand its own depreciation, operating expense, production expense, and taxes; but were it not for the 37 per cent. of rural business, the city business would have to be increased materially.

The Oregon Commission, realising this, decreased the rural rates and increased the city rate; and if the theory is sound, rural business may be justified, even at an apparent loss. The limiting factor is the quantity of rural business which a given city business can support; any low-priced business can be taken on which can be handled without actually increasing the rate on the original business.

Analysis shows that in the company's rural business 38 per cent. of the gross revenue uses 47 per cent. of the total investment, or 9 per cent. more than its normal share, which

carries taxes, interest, and depreciation, so that the excess reacts doubly against the net profits from the business. The problem is how to overcome this handicap; the solution is the adoption of new standards of construction—to which this business is particularly adapted.

Something has been done in this direction. Distributing lines of solid copper are in satisfactory use with 250-ft. spans; possibly copper-clad steel or other combination of metals may increase the span and lower the cost. Steel and reinforced concrete poles may solve the support problem, pole maintenance being high where pole investment is large. Insulated copper is entirely out of place for rural construction.

It has not yet been established what voltage is best adapted as a standard for rural work, nor which scheme of transformer connection is the best to adopt as a standard. Use is made of 110 volts for all single-phase circuits and 220 volts for most polyphase purposes; this offers the most flexibility of any scheme of secondary voltages. In the primary side delta-connected 3-wire, 6,600-volt and 2,200-volt systems are used. There is much to be said in favour of 4,000-volt or 11,000-volt star-connected grounded neutral primary circuit for rural work. It has the advantage of fewer necessary grounds, thereby lower grounding cost, and a further advantage of cutting out the circuit entirely by an automatic switch in case any of the three wires should be grounded, whereas the delta-connected 3-wire primary will sometimes operate with one wire down, at a great danger to pedestrians and traffic. It has the additional advantage of placing the ground on the high voltage side, and by grounding the secondary also the customer is rendered doubly safe. It gives an increase in voltage, hence lower copper cost, using the same transformers. A single wire can be run to handle single-phase distribution transformers, using the earth as a ground return. This has in some cases proved satisfactory. A plan which has saved considerable first cost has been the banking of transformers in multiple on both primary and secondary sides.

One of the greatest problems which must be solved by the manufacturers is the securing of a low-cost transformer. At present strictly domestic rural business is practically prohibited by transformer cost. Efficiency must be sacrificed in favour of first cost, and beauty of design and portability can also be sacrificed. It is possible that a transformer without oil, and with a tank made of sheet metal with ventilating outlets, can be designed to hang from a cross-arm with the leads brought out at the bottom without bushings, which will meet these requirements at half the present cost.

Up to this time the regulatory bodies have prescribed the same voltage variations for rural as for city business, and central stations have worked to these standards, but it is obvious that a greater range of variation will give a corresponding decrease in first cost, and this decrease will enable many customers to secure service which suppliers cannot afford to take on now.

The combination of electric supply and telephone lines on the same poles is another possible solution of part of this first cost item; a number of consumers could be profitably reached with the joint service, who cannot be reached by either service singly.

At Hood River over 50 per cent. of the consumers use motor-driven apple graders; about 20 per cent. use electric pumps. The average farm circuit has 35 outlets; some have 100; in some cases small street lighting systems are used.

By analysis it is found that the stock-raiser, dairyman, and mixed farmer give a better revenue than the apple grower. There is less labour which can be performed by electricity in the apple industry than in the others.

Rural business follows rather proportionally to acreage than population; one farmer using nine different farm machines—including a saw, thrashing outfit, cream separator, churn, cider mill, and hay-handling plant—drives them by a 15-H.P. motor; he guarantees the supply company $35 per month revenue, and frequently pays up to $75; he further states that his installation saves him $150 a month the year round.

The application of electricity to farm machinery is a field which has barely been touched. In the orchards of the principal fruit sections are thousands of spray machines driven by gasoline engines. Anyone going through a modern dairy farm will find a dozen uses for electricity. But this field will be developed rapidly when the power is made available.

The systems of rates adopted for city business have up to this time been applied to rural business, but the attempt to modify these to suit rural conditions has emphasised the need of revised methods of selling rural electricity. No doubt the eventual system for rural work will be flat rates based on maximum demand or demand control, but before this can be brought about to any great extent further investigation must be made into the business already developed.

The engineer must apply his energy to the problems of rural distribution before any great portion of the enormous revenue available can be secured.

The demand for electricity in the rural districts will be greater from year to year, and the means of distribution must be standardised, and we should profit by past experience and standardise before we secure the business, rather than doing it after much money has been spent in working along lines which are not permanent; and on the standards so adapted depends almost entirely the amount of business which a rural district will furnish.

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

By F. Gill and W. W. Cook, Members I.E.E.

This paper, of which an abstract was concluded in our last issue, was read and discussed in London on January 11th.

In opening the discussion, Sir Alex. Kennedy said the paper threw a great deal of light on what many of them would have to concern themselves with in 1931. Dealing with works in existence, much the most important question was what was the depreciated value of plant which had been used and had to be sold. Many electricity supply undertakings had to be sold compulsorily at a certain date, and the paper was especially useful in this connection. Depreciation was usually based on the straight line or one of the other methods shown, and he doubted whether it was possible to prove one method better than another provided the required result was obtained. If this was so, he did not suppose the system would be altered. But the second question was a matter of moment, and he believed the correct method was that advocated by the authors. The only previous examples of purchase had been tramway undertakings, in which the straight-line method had always been adopted, and the paper proved how unfair this was to the seller. It had no scientific basis whatever, and, as applied to purchase, he could not see that it had any justification. The authors' tables showed that successive purchasers paid much less by it than by the sinking-fund method. He asked what the authors meant by "life" of plant; to give it a period meant something that was going to be used, and if excessive use beyond the normal occurred the life would naturally become shorter, and this affected the depreciation allowance and income-tax, which was a point to be looked into nowadays.

Mr. J. S. Highfield said it was impossible to deal with the whole paper; he had always found that accountants disliked the slide rule and logarithms, as they didn't get their result in halfpennies. The engineer thought of the plant, while the accountant was more interested in the efficiency of the sovereign. The object of any business was to benefit the persons whom it was intended to supply, then to earn a profit. Every sound engineering business applied a sinking fund of its own to keep up the efficiency of the sovereign. The money was invested in some other business usually involving engineering, where a second fund was provided to meet the inadequacy of the other. Under the heading of renewals, he would class (1) day-to-day repairs, (2) extraordinary repairs, and (3) very long interval repairs. Improvements should also be classified under three headings: (1) Provision of better plant to improve the profit, for which a good balance should be set aside; (2) a sum should be provided to enable larger plant to take the place of existing old plant—as regarded this, it might be noted that the accountant often objected to the scrapping of old plant because it destroyed an asset; and (3) competition might force a reduction in prices, to meet which a fund should be accumulated out of profits and treated as an insurance. It was necessary that growth should take place, and fatal to stand still; extensions had to be provided for, and a sound cash position was necessary, the money being invested outside the business concerned. So far as could be judged, the transfer of an undertaking inevitably meant loss to both parties and to the public.

Mr. J. Swinburne mentioned having experienced some difficulty in grasping the relative values of the straight-line and sinking-fund methods of depreciation; in such a case it was a good plan to explain the case to others. This he did, taking a hypothetical case with a view to showing (if we understood him aright) that there was no real difference, if due credit was given for interest earned by the renewals fund, which was employed elsewhere in the business in the straight-line method.

Mr. J. E. Kingsbury said the importance of depreciation was generally recognised, but enterprises were suffering from the need of a wider knowledge of its application. He asked why, if there was an accurate method of depreciating assets, they should not adopt it?

Mr. E. S. Byng asked how they were to determine physical lives of plant, especially in the case of new types of plant. The division of the depreciation charge under two headings was interesting; he agreed that no ordinary crude method would enable them to obtain reliable figures.

Mr. Lawrence said it was obvious that any common-sense method of providing sinking fund would provide some return profit; this the straight-line method failed to do.

Mr. W. R. Cooper said he was afraid that some people after reading the paper would be inclined to run on too hard and fast lines. He felt that so many factors were involved that it would only be possible to obtain an accurate estimate of depreciation by some form of valuation, and this was the opinion of leading American engineering authorities.

Mr. E. K. Scott thought the common-sense man would work on the straight-line plan, because it was so easy. In practice, the purchaser wanted a curve under the line, and the seller wished for one above it, and mutual adjustment left them near the straight line. He suggested that interest might well be invested in a concern which was closely allied; in the case of an electricity undertaking, say, in a colliery. Many

useless assets were preserved by accountants, which were actually costing money to keep.

Mr. Cook, in replying briefly, said the authors regretted that the advocates of the straight-line method had not put in an appearance; he disagreed that the straight-line system was so easy to figure if, say, 19 years was chosen as the period instead of 20. It was not quite clear what was meant by day-to-day repairs, and he thought it was probably better to invest the sinking fund in the business itself, rather than outside.

Discussion at Birmingham.

The paper was discussed by the Birmingham Local Section on Wednesday, January 17th.

Mr. Henry M. Sayers said that it might seem to some a little strange that the authors had put together the return on capital and depreciation provision. This was, however, a correct view. The plant from the accountant's standpoint was a debtor to the proprietor or contributor under two heads. The first was that of return on capital, *i.e.*, profits, whether dividends or interest; the second was that of return of capital in such measure as to maintain the value of the undertaking by adequate renewal, or reduction of capital liability. There was some difficulty in calculating the economic life of plant. It required something of the prophetic instinct, since it involved an estimate or forecast of future developments in the art. The sinking-fund method of accumulating renewals and improvements funds, as advocated by the authors, was undoubtedly the sound and equitable one, and was the one which he had always adopted in calculations. The proof of its equity as between successive owners (or successive periods) was ingenious and convincing. With reference to the distinction between maintenance and renewals, there seemed to be no dividing line in principle. It was, however, convenient as equalising charges in successive periods to draw the line at the life corresponding to the accounting period, whether one year or any other period was adopted. Then renewals of any portions of the plant having a life period not exceeding the accounting period were charged as maintenance, while those of longer life were provided for from the renewal fund. This avoided anomalous differences between the periodic accounts, which, as the authors pointed out, were objectionable and, possibly, inequitable. The absence of the word "obsolescence" from the paper was an additional reason for thanking the authors.

Mr. T. Plummer said the paper had apparently been written to show the superiority and greater accuracy of the sinking-fund over the straight-line method of computing the depreciation allowance for plant, and the authors had made out an exceedingly strong case for the employment of sinking fund calculations in the preparation of ordinary commercial accounts. Mr. Gill had, however, mentioned in his introductory remarks that the paper was not intended to relate to the accounts prepared by municipalities working on borrowed money, and possibly the same applied to a concern run by the State, such as the telegraph and telephone systems. Anyhow, for the purpose of "considering the financial results of the working by the State of the telephone system of the country," the Postmaster-General appointed, in 1913, a strong committee of accounting, actuarial, and engineering experts, and, in preparing the statement of accounts for presentation to Parliament, they assessed "depreciation on the basis of the estimated effective life of the plant." The method followed was on the straight-line basis of equal annual instalments on an equated life of plant of 20 years (as estimated by the Engineer-in-Chief of the Post Office), due regard being paid to residual values. No doubt this decision was arrived at, as against the sinking-fund method, to conform with the usual practice of annual accounting for Government Departments, each year's votes being entirely independent, and to fit in with the system of Parliamentary control. Referring to the "constant maintenance cost" section of the paper, it was not his experience that the maintenance cost of telegraph and telephone plant was constant throughout its life. In the case of line plant, the maintenance cost was at a minimum for the first few years, then, as time went on, arms required straightening and wedging; wires got slack and had to be regulated; insulators, binders, and stays got loose, and had to be tightened up, all this having no connection with mere renewals in the sense of plant replacement. Again, a switchboard multiple gave comparatively little trouble when new, but when it approached the end of its effective life, the jacks got worn, and further troubles arose in the removal of faults in a large multiple field, which considerably added to the maintenance cost.

Coun. E. C. R. Marks said the authors had demonstrated the advantages of the sinking-fund method of providing for depreciation of plant. The particular method adopted was not, however, of such prime importance as the need for making the provision adequate. Engineers, like other people, were in danger of overlooking the needs of to-morrow in their anxieties for to-day. If they could keep the concern running now they were apt to pay too little attention to the avoidance of a funeral for their successors. Engineers were well acquainted with the principle of the indestructibility of energy and of matter. They could never command the confidence of those who financed their undertakings unless they recognised the theory of the indestructibility of capital, and made due provision for wasting assets. It was not always easy to estimate the physical life of a plant. It was always difficult to estimate its economic life, but it was the engineers' duty to do it, just as it was the duty of the medical adviser of an insurance company to estimate the life of an applicant for a life insurance or an annuity policy. When he had done so, the actuaries, accountants, and the like would soon fix up the annual premium required. That was not the doctor's job. Neither was it the engineer's job to settle just how the money set aside to maintain capital intact was to be dealt with. He had quite enough to do to keep his own end up.

Mr. F. J. Moffett said, in the section headed "Constant Maintenance Cost," it was stated that the renewal of each part, as it was required in turn, was provided for by the fund established on the basis of the equated physical life. It was therefore clear that an equated life, arranged for all the plant, provided money for the renewal of every part. He would be glad to know whether the authors proposed that a physical life should be fixed for every component part of an individual machine, and that from these separate physical lives, an equated life for the whole machine should be arrived at in order to calculate the renewals fund. In the case of a D.C. generator this would mean fixing physical lives for each item, such as armature core, pole pieces, yoke, armature winding, field winding, commutator, shaft, bearings, and brushes. If this system were adopted in the case of every machine, the process of calculating the equated life for each machine would be somewhat elaborate, and the allocation of the proportion of the renewal fund due for the renewal of each part as it failed would be a very complicated matter for the management of the firm or their accountants. It appeared to him that a much simpler and more satisfactory arrangement would be that the renewal of all parts, such as brushes, bearings, &c., which wear out in a relatively short period, should be charged to maintenance. It would be a comparatively easy matter to estimate the annual cost of such renewals and add this amount to the ordinary maintenance cost.

Dr. C. C. Garrard said this paper brought home the necessity in modern times of accurate cost-keeping. It was rather surprising to find, even among business men, a very vague idea as to what an engineering or manufacturing cost was. It was very often confounded with an estimate, and was regarded as a variable quantity which could be altered at will, depending upon the method of calculation used. This view was, however, entirely wrong. The cost which had been incurred in making a certain article, or in carrying out a certain operation, was a fixed and unalterable amount. The cost which would be incurred in repeating the work might well be different; once a job, however, was completed, its cost for that occasion was fixed. It might be difficult to find out what the actual cost was, but the value, although unknown, was essentially a fixed quantity. All proper systems of keeping costs aimed at arriving as nearly as possible at the correct figure. This question of cost-keeping was as important in a manufacturing works as it was in an electric supply station or telephone system. A works which had not a proper cost-keeping system as a basis for its official accounts was in the same position as that of a retail shopkeeper who did not know what he had given for his stock.

Discussion at Edinburgh.

The paper was discussed by the Scottish Local Section, at Edinburgh, on January 16th.

Mr. F. A. Newington (Edinburgh) differed from the authors in their definition of renewals. Whether they took wear and tear renewal or total renewal, it seemed to him something which had to be renewed either partially or wholly, and to talk about renewals which were really ordinary items of maintenance was not right. The term renewals should be reserved for the larger parts only. The manner in which municipal undertakings had to pay off their indebtedness was laid down very definitely in the Electric Lighting Acts. There was nothing about renewal or depreciation funds. They were allowed to provide for a reserve fund, and had to pay off the indebtedness by means of a sinking fund in a certain number of years, the interest payable being gradually reduced in ratio with the reduction of the capital originally borrowed. He had hoped that the authors might have devised some scheme by which, instead of payments decreasing annually, as many of them did, the payments should be less in the early days of the undertaking, when it was not earning full revenue.

Bailie M'Callum (convener of the Greenock T.C. Electricity Committee) explained that he disagreed with the authors, and also his Town Chamberlain, that the straight-line method was not the proper system for computing depreciation on municipal undertakings.

Mr. W. W. Lackie (Glasgow), in the course of a communication, pointed out that the question of depreciation and its relation to sinking fund was one that still remained undecided. Depreciation of value was met by a sum set aside for sinking fund, if such sum was properly calculated at the probable life of the plant. That was what Messrs. Gill and Cook called physical life. Decreased efficiency should be met by depreciation if the ordinary maintenance chargeable to revenue was not sufficient to keep the plant in its first state of efficiency. Obsolescence did not mean, and did not involve, true depreciation, but it was quite possible that a spending author-

ity owning works might look to the advantage which would be gained by installing new plant, and so getting greater efficiency than could be obtained from antiquated plant. Such an authority would annually set aside a sum for this purpose, and might be found dispensing with old plant in favour of more up-to-date plant, even although the former might not have reached the end of its useful life. It was not legal to create a deficit by setting aside a sum either in the name of depreciation or as a reserve fund. Only such sums as were profit were available for this purpose. The Court of Session in 1880 held that the deduction for wear and tear to be made under the Customs and Inland Revenue Act, 1878, was a deduction for diminished value as a means of earning income, and not as an available asset, and that inasmuch as the plant in question was undiminished in value for the purpose of earning income, no deduction from income-tax charge could be made beyond repairs already allowed for. He considered that there was really no principle involved in computing the depreciation of plant. The examples worked out in the paper were based on a 19 years' life, and he gave the following experience of what had happened in the principal power station in Glasgow recently. Ten years ago a 1,500-kw. generator and condensing plant were bought for £16,000. Depreciation had been written off this plant only, and it now stood in the books at £7,000, *i.e.*, they had written off £9,000 in 10 years. It was proposed to scrap this plant, and put down in its place a 6,000-kw. turbo-alternator costing £28,000. The new plant would save them £20,000 per annum in coal, and would pay for itself in 18 months, or the proportion of the 6,000-kw. set that the 1,500-kw. set represented would be paid in a year. So long as the plant was kept in first-rate condition out of revenue, and one was prepared to write off the difference between what the plant stood at in the books and what it would fetch if sold, the rate of depreciation might be so small as to be met by sinking fund. He argued that no fixed rate of depreciation should be agreed upon over a period of 20 years in an engineering works. One might have a very slack year, when the plant was only used for, say, the equivalent of 2,000 hours per annum, and in a subsequent year the same plant might be run for 6,000 hours per annum. The rate of depreciation would be quite different. In the early days of electricity supply for lighting purposes, they thought that a depreciation of 5 per cent. was liberal; but to-day, with new plant which was run practically continuously, a depreciation of 10 per cent. was required.

Mr. R. B. M'Call (Treasurer, Glasgow T.C. Electricity Department) could not assent to the statement of the authors that a general agreement on this subject was possible, and did not believe that the straight-line method condemned by the authors was so inequitable as alleged. Neither did he agree with the statement that the matter was largely one of fact. While it was true that depreciation of plant was a fact, the period of years in which total loss would occur was unknown, and therein lay the first difficulty in coming to an ordinary agreement. Depreciation was a premium of insurance, and all prudent people could do was to make a reasonable provision for the inevitable, but undateable, casualty by setting aside annually or otherwise a sum towards the probable date when the plant would be done, and new plant would have to be provided. He gave instances where plant had existed for 80 years, much beyond its estimated life; and also a case of a patent which, while quite good at the time, was superseded almost immediately by a cheaper method of producing the article which was the subject of the patent. He thought the authors had wrongly obtruded certain factors into the question, such as the annual return of plant and maintenance, neither of which had to do with the question. If these were eliminated the subject became much simplified, and on the assumption that an annual instalment should be put aside for renewal of plant, all that remained was—should this sum be on the straight-line method or on the annuity or sinking-fund method? He came to the conclusion that the straight-line method was as beneficial to the undertaking on the whole as any other method, because it called for an equal sum each year (not a decreasing sum, as alleged by the authors), and that being so, it was just as equitable as the sinking-fund method, which required more book-keeping, or the annuity method, which required a certain amount of actuarial calculation. He challenged the authors' tables as being based on a wrong hypothesis, and that, therefore, the conclusions come to were wrong. He thought there was no difficulty either in the cases where there were three units of plant each of the same value, but all different lives, nor where the items were of different values; it was only a matter of simple calculation. Where the physical and economical life (obsolescence) entered into the calculation, the economic life, being the shorter of the two, must be the life on which calculations for depreciation should be founded, and that it was not possible to give an equation for the physical life and the economic life of the same unit of plant, although it was quite possible to equate the physical life of one class of plant and the economic life of another class. As to depreciation reserves invested in the business, he held that the result to the undertaking was the same whether they borrowed £100 and continued to pay interest on it while receiving interest on £5 of a depreciation fund set aside, or repayed the loan to the extent of £5, and payed interest on £95. In both cases the interest was paid on a net sum of £95.

Mr. Gill briefly replied.

INDUSTRIAL RESEARCH.

At a meeting of the Newcastle-on-Tyne Local Section of the Institution of Electrical Engineers, on January 22nd, Mr. A. P. M. Fleming delivered an address on "Industrial Research, with special reference to American Research Activities." Mr. Fleming said that during the past two years most of the industries of the country had been put on a war footing, sooner or later, and soon, it was hoped, a readjustment would have to be made to put them on a peace footing. That readjustment involved a number of serious problems, and amongst them would be the re-arrangement of every manufacturing facility on the most efficient and productive lines. This would be necessary, in the first place, to make up for some of the wealth depleted by the war, and also it was necessary to carry out reforms that were needed before the war, and which would be still more urgently needed after the war in order to place them in a position to compete favourably in international markets. The two great assets they had to draw upon were the natural and mineral wealth of the country, and the vast store of mental and physical capacity of the community. Education and research were the two channels by which that treasury might be tapped. Broadly speaking, research meant nothing but the acquisition and application of new knowledge, and it was indisputable that industrial progress depended on the acquisition and application of new knowledge. In engineering, more than in most industries, the importance of research was paramount; especially was that the case with electrical engineering, the progress of which from the time of the birth of the dynamo had been dependent entirely on scientific investigation and application. For instance, he mentioned that the present state of electrical illumination and wireless communication had been the result of the solution of far-reaching problems in physics. While in engineering they acknowledged the importance of research, and engineers appreciated the need of research, it did not, he thought, so appeal to the whole community, and yet the whole community was affected by research. Thus, to the manufacturer it was of the utmost importance Perhaps its greatest field for usefulness lay in the development of new and improved materials. Another important field was the development of processes for cheapening production. An important phase was that of researches leading to the development of entirely new products, in which priority of manufacture could be secured and maintained. In the past we had sometimes achieved this priority, but had not retained it. The importance of securing and maintaining priority need not be enlarged upon, and in this connection it might be noted that we had far too restricted a vision as to the possible creation of markets, and confined our attention to markets that already existed. To the worker, too, research was of considerable importance, and he suggested that research might be used as a sort of industrial flywheel in those changes from good to bad trade. To the financier research was of importance, inasmuch as it opened to him new fields for the profitable employment of capital. In consideration of the educationist's point of view, the latter was interested in research work, for it would involve increasing demands upon him for the training of men for all classes of work. Referring to international research, the speaker said that prior to the war great strides had been made in Germany in research work, and it was likely that considerable progress had been made during the war; and it was well to remember that, whatever financial burden might be placed on Germany after the war, she would still retain her organising, scientific, and industrial capacity. In the Far East the Japanese Imperial Treasury had devoted considerable sums recently to research, and some industrial competition might be expected from this quarter when the cheap labour and industrial aptitude were taken into account. In the United States much progress had been made in research in recent years. The prosperity of that country resulting from the war had still further enhanced her capacity in this direction, and, despite some handicap from abnormally inflated wages, America would be a most important competitor for the world's markets. The lecturer then showed a number of highly interesting slides illustrative of the importance that was attached to research work in the States. In conclusion, he said that in the organisation of British industrial research, consideration must be given to the character of our markets, and where international markets had to be considered, it was essential that research facilities should be organised for the benefit of the whole industry. Whatever national plans might be developed in this country, it was desirable that they should include provision for co-operation with research activities in other parts of the Empire, so that by this means we might present a united scientific front to the world in support of our industries, not less formidable, and not less effective than that shown in military matters during the present conflict.

The Chairman (Mr. H. W. Clothier) said he thought, in view of what America had done in research, we were fortunate in being able to produce things, and good things, in this country, although we had not had any of the organised research work such as Mr. Fleming had mentioned.

Mr. F. O. Hunt said he thought it spoke well for the brain-power of our people that we had been able to hold up our heads, and he thought that the individual tendency of the British was one of our great assets, one which, in our efforts to organise, we ought to look carefully after that it should

not be sacrificed. He referred to the magnitude of the research schemes in the States, and said that working it out very roughly, it came to something like £1,000 per man per year for upkeep. That was a kind of figure that rather staggered the imagination of those who knew how research work was treated in this country. The hostility of the workers to inventions was a matter of history, too, and he thought there was a great opportunity, if only we had an elementary education system worthy the name, of broadening the views of the people in this matter. As to the financial element, he did not think that financiers recognised the possibilities of research work at all. One thing that had struck him very much was the apparent willingness of the authorities in the States to impart knowledge. Here it was well known how jealous firms were of their secrets. The fault of many manufacturers here was that they did not take a long enough view.

Mr. Turnbull referred to the manufacture of tungsten lamps, and said that the Germans when they introduced them declared that no one should know the secret of their make, but, by our patent laws, they had been compelled to establish a factory here before they could get a patent.

Mr. A. P. Pyne also referred to the German side of the question, and said they must not overlook the fact that a great amount of research work had been done in that country, quite equal to that carried on in America.

Dr. Thornton suggested that something of the British position was, perhaps, due to a want of encouragement of research work, and he contrasted the position here with that in the States. An illustration he mentioned was that at Armstrong College, there was this year a grant to his department for apparatus, including repairs and new instruments for research, of £18 per annum. We had managed well enough for 100 years, but these magnificent research endowments in America were only 15 years old, and we could not hope to hold our own in the world's markets in the future unless our leaders of industry realised the extremely efficient competition now being organised.

Mr. Fleming, replying to the discussion, said that while he admitted the great value of the individuality of the British, they must realise that research work to be really effective could best be carried out on a large scale, and as individual works were not yet able to bear the cost of a big-scale undertaking, he thought it was necessary to modify their views, and adopt some change that would secure the benefits of co-operation, and minimise in every way the loss of individuality. He admitted that the capitalist had much to learn, for he did not realise the importance of the work in question.

THE WORK OF THE B.E.A.M.A.

[The Annual Report.]

The report of the Council of the British Electrical and Allied Manufacturers' Association for the year 1916 has just been issued.

After referring to the anxiety of the electrical and allied industries to place their best service at the disposal of the Empire in supporting its determination to see the way through to victory, the Council states that a present anxiety is in regard to the export trade, the development of which has been considerably hampered by abnormal manufacturing conditions created by the necessities of war.

Practically all the works of members are "controlled," *i.e.*, engaged mainly or exclusively on the manufacture of munitions of war; and it has not been possible to supply the demands of established overseas trade connections, a considerable volume of trade in our Overseas Dominions as well as in neutral markets being diverted into the hands of American, Japanese, and other competing manufacturers. It is believed this lost ground will be speedily regained when British manufacturers are again in a position to re-enter it, and the Empire's purchasers realise what home producers have sacrificed in the common cause.

Meanwhile, the Overseas Committee of the Council in India, South Africa, and Australia continue to use every endeavour to foster in their respective territories those co-operative principles which have been beneficial at home. The Australian Overseas Committee has been successful not only in drawing up general conditions of contract for electrical and engineering work, but in obtaining for them the official approval of the Electrical Association of Australia. As that Association comprises in its membership many of the important buying engineers in the Commonwealth, including the engineers of Government departments and municipalities, there is little doubt that the conditions will in time become the recognised standard for all public contracts. They have already been adopted by several important public bodies.

Progress is being made in the same direction in India and South Africa.

An energetic Overseas Committee, recently formed in Buenos Aires (Argentina), keeps in touch with representatives in Rio de Janeiro (Brazil), where, it is hoped, a separate Committee may soon be formed.

A small Committee has also just been formed in Moscow (Russia), from which useful work is anticipated. The experience gained with the Overseas Committees has shown the desirability of broadening the basis of their constitution, and steps are being taken to enlarge their scope and to make it possible to establish committees in other countries. In addition, useful reports have been received (and circulated to members) from correspondents in Rio de Janeiro (Brazil), Rosario (Argentina), China, France, various parts of Australia and South Africa, &c.

The Council has decided to publish special editions of the *Journal* in the Russian, Spanish, and Portuguese languages, provided adequate advertising support is received from members. It is believed that these issues will be of great assistance in promoting the interest of members in Continental and South American markets.

The Council has issued in handy form a set of British export standardisation rules for electrical machinery and transformers (excluding traction motors). The text of these has been settled as far as possible in accordance with present international standards and after agreement with the sections of the Association mainly interested. It is believed that these rules will, if energetically circulated, tend to displace those issued by other countries for use abroad. Translations into French, Spanish, Italian, Russian, and Portuguese will shortly be available. Members can obtain from the Secretary, at a nominal charge, editions in English or any of these languages bearing their own imprint, for circulation to their foreign agent and customers.

The Association is frequently approached by various Government Departments for information. Members of the Council have discussed with the Foreign Trade Department matters surrounding overseas trade, and the latter department from time to time furnishes advance information of use to members which is duly circulated.

Under direction of the Association's Trade Committee, formed at the end of 1915, propaganda work was undertaken with the object of impressing on public opinion at home the indispensability of a powerful and prosperous engineering industry, both in war and peace.

It may fairly be claimed that if there is by this time general enlightenment on this question, the work of the Trade Committee had some useful share in arousing public interest, and the points which it endeavoured to bring out with prominence are to-day widely understood and appreciated.

On behalf of the Committee, Mr. T. C. Elder delivered lectures before large audiences in Birmingham, Manchester, Glasgow, Newcastle, Liverpool, and Nottingham, and organised a successful meeting at the Mansion House.

At the same time a large number of pictorial leaflets and reprinted reports of the meetings has been distributed, the total publicity effect of which cannot be precisely estimated. The Committee has, however, reason to believe that the mission thus undertaken by the electrical and allied industries has been warmly approved by other branches of engineering. The expenses of the propaganda work were met by sectional contributions.

The Council appointed certain of its members to appear and give evidence before the Committee appointed by the Board of Trade "to consider the position of the electrical trades after the war, with special relation to international competition." Evidence was given on the following subjects: (1) Restrictions of imports by a scientifically-devised tariff; (2) the spending of public money, raised on the security of rates and taxes, in the interests of British industry; (3) railway and shipping handicaps on British industry; (4) the need for a ministry of commerce and industry; (5) education in its relation to industry; (6) the need for standardisation, and the co-operation of Government departments with British manufacturers in this connection; (7) the abolition of legislative handicaps on the electrical and allied industries; (8) the need for the co-operation of finance and industry; and (9) amendments in the laws relating to patents, trade marks, &c. The evidence presented was well received, and the Association's witnesses were complimented by the Committee on its exhaustive character. It is understood that those specific recommendations to which the Association attach the greatest importance are likely to be adopted by the Committee and warmly commended to the Government.

The shortage of ships has necessitated the prohibition of many imports, and the prohibiting regulations fell heavily for a time on the electrical industry among others. Representations made by the Council to the proper department, showing that the import of certain insulating materials was an urgent, if temporary, necessity, resulted in the Association being granted a licence to import, for the benefit of the industry at large, those materials for which there was urgent need.

The Turbine Section of the Association has resolved to establish, at various university industrial centres throughout the kingdom, scholarships for the promotion of the practical study of steam problems, especially as related to turbine work. Similar endowments of scholarship in other branches of industry are now, or will shortly be, under consideration.

The Association's General Committee for Research, created at the invitation of the Privy Council Advisory Committee, has established working Sub-Committees to deal with the improvement of insulating materials, the corrosion of condenser tubes, special waterproof insulation for machines, magnet steel, problems of switching and arcing, turbine blading; and certain applications for grants-in-aid of research have already been lodged, while others are in preparation.

Meanwhile, the preliminary investigations, aimed at ascertaining the most urgent subject matters for further work, are being conducted.

It was hoped that certain researches could have been conducted jointly with the Institution of Electrical Engineers, but this has not so far been found practicable.

(To be concluded.)

A COMMITTEE OF PROVINCIAL ELECTRIC SUPPLY COMPANIES.

A NEW Committee has been formed, which will be known as the Provincial Electric Supply Committee of Great Britain, with the principal object of providing a central and representative body to afford a ready means of co-operation in protecting and furthering the financial, commercial, and legislative interests of provincial electric supply companies working under provisional orders. The following are members of the Executive Committee, the Committee being limited to directors only:—

H. B. Renwick (chairman), Bournemouth and Poole Electricity Supply Co., Ltd., and other provincial companies.

Sir J. S. Harmood Banner, M.P., Midland Electric Corporation for Power Distribution, Ltd.

F. E. Gripper, Edmundson's Electricity Corporation, Ltd.

G. W. Spencer Hawes, Reading Electric Supply Co., Ltd., and other provincial companies.

J. Atkinson Hosker, County of Dorset Electric Supply Co., Ltd., and other provincial companies.

W. L. Madgen, British Electrical Federation, Ltd.

Sir Henry C. Mance, Oxford Electric Co., Ltd.

R. P. Sloan, Newcastle-upon-Tyne Electric Supply Co., Ltd.

J. G. B. Stone, Electric Supply Corporation, Ltd.

J. C. Wigham, Urban Electric Supply Co., Ltd.

The Committee proposes to direct particular attention to the following matters:—

1. To organise and arrange for united action in protecting common interests as and when occasion arises, and such united action is necessary and desirable.

2. To afford the readiest means for considering such questions as rating, income-tax, assessments, excess profits tax, emergency and other legislation, rates for supply, fiscal and other matters generally affecting the companies' interests.

3. To prepare, collect, and distribute amongst the members statistics or other information of common interest, and to print and issue other literary matters for the use of members desiring to avail themselves of the facilities offered.

4. To afford facilities for intercourse between the directors of the companies represented on the Committee with a view to the consideration of any questions affecting the common interests.

5. To watch over the interests of the companies, and take any steps expedient with a view to correcting mis-statements that may appear in the public Press.

6. To assist in the compilation of official statistics and information on a uniform basis, where such is desirable, and to the benefit of the companies.

7. To appoint sub-committees to deal with any special matters arising, and generally to initiate, organise, and carry out any work having for its object the protection or furtherance of the interests of the companies.

As our readers are aware, the municipal electric supply undertakings, both in London and the provinces, already have their Associations, while the electric supply companies in London are also similarly represented by a committee, as are likewise the power companies of the country. By means of this new Committee the electric supply companies in the provinces, who up to the present have had no representative organisation, will be provided for. That there is need for some such organisation will be obvious when it is borne in mind that many of the provincial companies are small, and have neither money for organisation nor facilities for taking the proper steps to further or protect their interests on any broad legislative or fiscal lines, and they are scattered about in all parts of the United Kingdom. They will now have the means for co-operating through a central representative body. It is appropriate, in this connection, to recall the successful co-operation of the provincial companies in regard to excess profits.

Mr. H. B. Renwick organised the appeal on behalf of the industry, and, in view of the general feeling expressed that a representative organisation should be formed at once, he took the matter up with a view to the formation of a permanent central body. The outcome is this new Committee.

Such an organisation should be of benefit to the small isolated companies. It will be useful to deal with new problems which may arise in times like the present, and to watch over the interests of the electric supply companies if they are affected by further Finance Acts or similar legislation. We understand that the main objects of the Committee will relate to financial, commercial, and legislature work, and the executive committee have been appointed for their experience and ability in this direction.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

713. "Electric lamps for motor vehicles, &c." C. F. L. KING. January 15th.

720. "Electric illuminated rudder indicator." J. CARSON. January 15th.

732. "Galvanic batteries." E. A. ASHCROFT. January 15th.

740. "Automatic telephone systems." B. B. JOHNSON & RELAY AUTOMATIC TELEPHONE Co. January 15th.

749. "Phase transformation of electric currents, and transformers therefor." BRITISH ELECTRIC TRANSFORMER Co. & R. CROSBIE-HILL. January 15th.

752. "Electro-magnetic signalling apparatus." G. HENDERSON. January 15th. (U.S.A.) January 13th, 1916.

767. "Electrically-illuminated indicators for personal wear." C. HARTLEY. January 16th.

773. "Commutators and collecting rings." W. MCLOUGHLIN. January 16th

788. "Carbon holders of electric arc lamps." W. L. HUMPHRIES. January 16th.

802. "Cord-grips for lamp wires." C. G. M. BENNETT. January 16th.

807. "Lamps or lanterns for light projectors, such as searchlights, headlights, &c." H. SCHOLEY (Soc. Anon. des Phares et Lanternes Tub.). January 16th.

819. "Dynamo-electric machines." F. P. FLETCHER & H. F. JOEL. January 16th.

851. "Semi-automatic telephone exchange systems." WESTERN ELECTRIC Co. (Western Electric Co., U.S.A.). January 17th.

860. "Electric batteries." H. D. HENRY. January 17th.

892. "Electro-medical apparatus." E. E. GREVILLE. January 18th.

894. "Windings of electric motors and generators." J. S. HIGHFIELD. January 18th.

910. "Electrical keyboard transmitting apparatus and electrical signalling or advertising systems." H. K. HARRIS. January 18th.

930. "Auxiliary apparatus for telephones." F. C. C. V. NARSER & N. A. J. LILLIENDAHL-PETERSEN. January 18th. (Denmark, January 20th, 1916.)

931. "Electric couplings, and cases therefor." N. J. AUSTIN & W. E. TAYLOR. January 18th.

934, 935. "Electro-deposition of copper." S. O. COWPER-COLES. January 18th.

936. "Process for production of copper tubes." S. O. COWPER-COLES. January 18th.

937. "Recovery of copper from weak copper sulphate solution." S. O. COWPER-COLES. January 18th.

943. "Electric motor control." A. G. COOKE. January 18th.

955. "Electric switches." K. HOHN. January 19th.

974. "Systems of electric ship propulsion." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). January 19th.

999. "Dynamo-electric machinery." ELECTROMOTORS, LTD., E. GREENWALCH AND B. LONGBOTTOM. January 20th.

1,017. "Suspender for electric cables, &c." W. T. HENLEY'S TELEGRAPH WORKS Co. & R. POVEY. January 20th.

1,026. "Telephone, &c., receivers." F. SON. January 20th.

PUBLISHED SPECIFICATIONS.

1915.

13,750. RELAYS OR APPARATUS FOR AUGMENTING THE EFFECT OF SMALL ELECTRIC CURRENTS. W. M. Mordey. September 27th.

18,047. MANUFACTURE OF RIGID PIECES OF METAL INSULATED AGAINST ELECTROLYSIS AND CORROSION. P. M. Stewart. December 28th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

250. FUSES FOR PROTECTING ELECTRIC CIRCUITS. A. Schaaning & S. A. Stigant. January 6th, 1916. [102,824.]

346. ELECTROLYTIC DEPOSITION OF A COBALT-SILVER ALLOY. P. Marino. January 7th, 1916. [102,828.]

586. ELECTRICAL CONVERTERS AND BALANCERS. M. Walker. January 13th, 1916. [102,836.]

1,263. METHOD OF IGNITION IN INTERNAL-COMBUSTION PUMPS, COMPRESSORS, OR ENGINES, AND APPARATUS THEREFOR. H. A. Humphrey & W. J. Rusdell. January 26th, 1916. [102,842.]

1,884. PROCESS FOR THE MANUFACTURE OF NITROGEN COMPOUNDS. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. February 23rd, 1915. [100,039.]

2,283. DYNAMO-ELECTRIC MACHINES. M.L. Magneto Syndicate & E. A. Watson. February 15th, 1916. [102,845.]

2,345. ELECTRIC HEAT RADIATORS. A. F. Berry. February 16th, 1916. [102,846.]

4,962. ELECTRICAL DRIVING, PARTICULARLY FOR MOTOR VEHICLES. H. Crochat. April 4th, 1916. [102,864.]

5,769. SIGNALLING SYSTEMS AND APPARATUS THEREFOR, MORE PARTICULARLY FOR USE IN MINES. Automatic Telephone Manufacturing Co. & H. Green. April 20th, 1916. [102,868.]

6,982. TERMINAL SEAL FOR BATTERIES. E. W. Jefferson. May 21st, 1915. [100,534.]

8,633. ALTERNATING-CURRENT COMMUTATOR MOTORS. British Westinghouse Electric & Manufacturing Co. June 19th, 1915. [100,743.]

8,794. ELECTRICAL IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. C. F. Kettering & W. A. Chryst. July 16th, 1914. (Divided application on 7,758/15.) [100,747.]

9,099. MEANS FOR CONTROLLING ELECTRIC MOTORS. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 28th, 1916. [100,880.]

10,745. ANODES FOR ELECTROPLATING. G. Jones. July 29th, 1916. (Addition to 17,328/15.) [102,897.]

11,859. AUTOMATIC TRAIN-STOPPING DEVICES. A. L. Lyttle & C. I. Costello. December 22nd, 1915. (Divided application on 17,923/15.) [100,904.]

13,631. ATTACHMENT OF MAGNETOS TO THE POWER UNITS OF MOTOR CYCLES. G. T. B. Sangster. March 22nd, 1916. (Divided application on 4,217/16. [102,913.]